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ON OVIPOSITION AND NURSING IN THE BATRACHIAN GENUS DENDROBATES.

BY HERBERT H. SMITH.

IN 1875, while at Santarem, on the Lower Amazon, my attention was called to a brown frog which was very common in the damp forests of the highland, hopping about under the trees. I frequently saw it several miles from any stream or pool. The hunters told me that this frog carried its young on its back. I offered a high price to any one who would bring me a specimen with its young, but no one took advantage of my offer; and though I was collecting every day in the woods where the frog was so common, I never saw the young at all. I finally concluded that my informants had confounded this species with the Surinam toad, which is probably found at Santarem, though I never saw it there; so I dismissed the subject from my mind. My specimens of the frog were lost, with other batrachians and reptiles, on the voyage to New York, but I hope to determine the species with fresh examples at some future time.

One day in October or November, 1884, I was camping in a lonely spot forty miles northeast of Cuyabá, in Western Brazil; the place was on the *chapadão*, or table-land, close to a deep, rocky ravine. All around were little tracts of damp meadow, such as are frequently seen even on the higher portions of the *chapadão*. Brazilians call such spots *varzeas*, a name also applied to the grass-lands on river-plains, to which these patches have only a superficial resemblance. The *varzeas* of the highland

always lie above a layer of hard rock, on which water accumulates in the rainy season, soaking the thin layer of loam and turf which covers it. At such times there may be half a dozen little streams flowing through a spot of *varzea* over smooth rocks, where the subsoil has been washed away; but in the long dry season, from May to October, the water evaporates, the ground dries up and cracks, the grass on it withers, and generally the streams disappear. The plants and animals of the *varzeas* are different from those of the rest of the table-land, the species being adapted to endure these periodical changes. The place that I am speaking of is quite dry during four or five months of every year, and even the ravine at its side has no water; at that time the nearest stream is several miles away.

Wandering over the meadow, now sodden with a recent rain, I observed a small frog of a kind which I had frequently seen on the *varzeas*. Some peculiarity in its appearance made me examine it more attentively, when, to my astonishment, I saw that its back was covered with little black bodies, set close together like paving-stones on a street, if I may compare small with large; the entire upper surface of the frog, except the head, was concealed by them. I very quickly saw that these were tadpoles, so crowded in the small space that the tails and part of the bodies were hidden. They were moist and glistening, as if they had just been taken from water, though the sun was shining hotly over them. If my observation was correct, they were kept in place by a viscid secretion, either from their own bodies or from that of the parent. They moved slightly while I was watching them.

Up to this time the frog, with its little colony, had remained quite still, so that I had a good opportunity to examine it; but when I attempted to secure it, it hopped into a patch of grass, where, despite of all my searching, I could not find it. I judge that it entered some hole among the grass-roots. Heartily appreciating the fact that a frog in the hand is worth two in the bush, I was obliged to content myself with an entry in my note-book of what I had seen and a resolve to observe the species more carefully in future.

I frequently saw the frog after this, but could never get it with its young. Nearly a year after, my assistant, Mr. W. C. Smith, found a specimen with its colony of tadpoles on a *varzea* very

similar to that I have described and in the same region; this he secured, and it is now in the possession of Professor E. D. Cope. Mr. Smith writes me: "Four of the young, I believe, dropped off and were lost; being in a hurry, I threw the frog at once into a bottle of alcohol, and I did not observe how the young were attached to the back."

These very imperfect observations are all that I can give concerning the habits of this very singular batrachian, but I hope that they may serve to direct the attention of other naturalists to these species. The Santarem frog mentioned above was similar in form to this one, though a good deal larger, and very likely it belongs to the same genus. In view of my observations on the *chapadão* species it seems probable that the information given by the hunters was correct, and that the Amazonian frog also carries its young on its back.

In both cases there seems to be an evident adaptation of the habits to the surroundings. The Santarem forests are always moist and comparatively cool, but the absence of standing or running water in those parts where the frog is seen would prevent the ordinary disposition of its young. The *varzeas*, on the contrary, are wet and even partly flooded after rains; but even in the height of the rainy season the pools and streams may dry up if a few days pass without showers. If the young frogs were left in the water they would run the risk of being destroyed before their development was completed. In the dry season the frog, like most other animals, disappears from the *varzeas;* probably it retires to some crevice where it can remain sheltered until the rains set in again. Both the frogs observed with young were seen at the beginning of the rainy season.

It would be interesting to know how the young (or eggs) are first placed on the back of the parent and how they are nourished.

I may notice here that the bright spots on the legs of this frog and of other species serve in a very curious way to conceal the animals. They are only visible when the frog is hopping, and their sudden disappearance when the animal comes to rest causes one to lose sight of it altogether; for the eye naturally follows the bright colors, and perhaps they have the effect of momentarily dazzling it, so that the sombre general surface of the frog, very like the ground on which it sits, becomes for an instant

invisible, just as a small dark object becomes almost invisible immediately after gazing at a scarlet cloth or a candle. I have noticed similar effects produced by color-spots in certain insects, especially the butterflies, which are often vividly colored on the inner surface of the wings, so that they are extremely conspicuous when flying; but as soon as the insect comes to rest these colors disappear, and the plain outer surface of the wings is, by contrast, momentarily invisible.

NOTE BY E. D. COPE.—Examination of the specimens collected by Mr. Smith shows that they belong to a species of the genus Dendrobates, which I have described under the name of *Dendrobates braccatus*.[1] It agrees in most of its characters with *D. trivittatus* Spix., but is very much smaller, not measuring half its linear dimensions. As the specimens are, according to Mr. Smith, adult, they must be regarded as specifically distinct. It is also related to the *D. hahneli* of Boulenger,[2] but differs in the considerably shorter posterior limbs.

Dendrobates braccatus Fitzinger. Views from side and below. Copied from Steindachner. (None of my specimens have so much black below.—E. D. C.)

The singular manner in which this species carries its larvæ constitutes a method of nursing distinct from any of those enumerated by Mr. Boulenger in his table in the *Annals and Magazine of Natural History for* 1886, of which I give a copy, inserting the Dendrobates:

I. The ovum is small and the larva leaves it in a comparatively early embryonic condition.

A. The ova are laid in the water.

Probably the majority of Batrachians; all European forms except Alytes.

B. The ova are deposited out of the water.

a. In holes on the banks of pools, which become filled with water after heavy rain, thus liberating the larvæ.

Leptodactylus ocellatus, L.; *L. mystacinus* Burm.; *Paludicola gracilis* Blgr.

b. On leaves above the water, the larvæ dropping down when leaving the egg.

Chiromantis rufescens Gthr.; *Phyllomedusa jheringii* Blgr.

II. The yolk-sac is very large, and the young undergoes the whole or part of the metamorphosis within the egg; at any rate the larva does not assume an independent existence until after the loss of the external gills.

[1] Proceedings Amer. Philosoph. Soc., 1887, April.

[2] Proceed. Zool. Soc. London, 1883, p. 636, Pl. LVII., Fig. 4.

A. The ova are deposited in damp situations or on leaves, and the embryo leaves the egg in the perfect air-breathing form.

Rana opisthodon Blgr.; *Hylodes martinicensis* D. & B.

B. The ova are carried on the parent.

a. By the male.

a. Round the legs; the young leaves the egg in the tadpole state.

Alytes.

β. In a gular (the vocal) sac; the young is expelled in the perfect state.

Rhinoderma.

b. By the female.

a. Attached to the belly.

Rhacophorus reticulatus Gthr.

β. Attached to the back;

aa. The young completes its metamorphosis within the egg.

Pipa.

bb. The free tadpole is carried on the parent.

Dendrobates.

γ. In a dorsal pouch.

aa. The young leaves the pouch in the tadpole state.

Nototrema marsupiatum D. & B.

bb. The young leaves the pouch in the perfect state.

Nototrema testudineum Esp.; *Opisthodelphys ovifera* Weinl.

It approaches nearest to the habit of the *Pipa monstrosa*, which also carries the young on the back. But, as is well known, the skin itself and not a gelatinous secretion encloses the eggs in that species and retains the young until the metamorphosis is complete. The Dendrobates, however, furnishes a hint as to the origin of the temporary growth in Pipa.

Several larvæ accompany one of the specimens of this species, which are stated by Mr. Smith to have been adhering to its back when it was taken. They do not resemble those of Pipa, but rather those of Rana or Bufo. The branchial opening is on the left side, and no limbs are developed. The tail is long. The mouth is not peculiar. The decurved lower lip is present, and is furnished with two transverse series of bristle teeth. A single series of the same extends entirely across the superior labial region, above the upper horny jaw. The papillæ are rather long, and extend all round the inferior lip, and for a short distance on each side at the lateral end of the upper lip, the series presenting an entering angle opposite the mouth. This species is described and figured[1] by Steindachner in the *Verhandl. der. k. k. zoölog. botan. Ges. in Vienna*, 1864, p. 258, who refers it to the *D. trivittitus* ("*nigerrimus*"), under the impression that the specimens before him are not adult. He states the latter were labelled *Dendrobates braccatus* by Dr. Fitzinger. This name is not adopted by Steindachner.

[1] Plate XIII., Fig. 2.

THE TACONIC QUESTION RESTATED.

BY T. STERRY HUNT.

(Concluded from page 250.)

§ 29. It must be further noted that the term Taconic, unless qualified and limited as Upper Taconic, includes, besides this Cambrian, another and a not less important series of rocks which cannot be brought into parallelism with either Cambrian or Silurian, and is separated from the Upper Taconic by great lithological differences, as well as by stratigraphical relations and by geographical distribution. We have shown that Eaton long ago pointed out the well-marked stratigraphical discordance between the base of the First Graywacke and the Transition Argillite; and it is also to be observed that the Lower Taconic, which consists of this Argillite (called by Emmons the Magnesian Slate, but including a band of roofing-slate), of the Primitive Lime-rock or Stockbridge limestone, and of the Primitive Quartz-rock or Granular Quartzite, is in many places wanting at the base of the First Graywacke. Indeed, it is not recognized by its distinctive characters along the western border of the Atlantic belt anywhere within the province of Quebec or in northern Vermont; where the Upper Taconic rests upon more ancient crystalline hornblendic and chloritic rocks very unlike the Magnesian slate of Emmons, and where, moreover, neither the Primitive Lime-rock nor the Primitive Quartz-rock are known.

That the green sandstones and conglomerates which make the basal beds of the Upper Taconic contain the ruins of these older crystalline rocks, was already noticed by Emmons, and is seen at many points, notably at Pistolet Bay, in Newfoundland, where a great body of these rocks, which were referred to the Sillery division of the Quebec group, rests directly upon a series of hornblendic and chloritic rocks with serpentines. This immediate superposition of the Sillery sandstones to these crystalline schists was explained in Logan's hypothesis by the double assumption that the green sandstone is the uppermost member of the so-called Quebec group and has escaped an imagined alteration, and that the immediately underlying crystalline rocks belong to the Lauzon or middle member of the same group,

which has been altered. When, subsequently, Logan traced the great Graywacke belt of Eaton southwestward into Vermont, and along the western base of the Taconic Hills to the Highlands of the Hudson, recognizing its identity with his Quebec group, and finding it, in its southward extension, to rest in many parts on the crystalline limestones of the Lower Taconic (the Primitive Lime-rock), he declared these to be the altered representatives of the Levis or Sparry Lime-rock, made by him the lowest division of the same Quebec group; the Lauzon, according to his hypothesis, while nearly four thousand feet in the vicinity of the city of Quebec, being elsewhere reduced to a very thin layer, or entirely wanting.

§ 30. That the great crystalline series which forms the Lower Taconic of Emmons lies, as maintained by Eaton, beneath the horizon of the First Graywacke, from which it is separated by a stratigraphical discordance, is thus confirmed by Logan, as well as by J. B. Perry, who, in 1867, described the Lower Taconic as consisting of quartzites, marbles, and talcose schists; and, later, by Marcou, who also notes the want of conformity between the Lower and Upper Taconic. That the horizon of the Lower Taconic is in fact below that of the First Graywacke is disputed by no one who has ever studied the region in question, and the only ground on which it can be assigned to a higher horizon is by maintaining the old error of Mather, who conjectured this First Graywacke or Upper Taconic to be newer instead of older than the Trenton limestone,—a mistake now recognized by all who have investigated this Graywacke belt.

We have elsewhere pointed out the grounds on which those who followed the erroneous view of Mather as to the horizon of the First Graywacke regarded the Lower Taconic quartzites and limestones as Trenton or post-Trenton in age. C. B. Adams and W. B. Rogers regarded the Red Sand-rock and its associated limestones near Burlington, Vermont, which are included in the First Graywacke, as of Medina (or Medina and Clinton) age. Following this, Adams maintained, in 1846, that the quartzites and crystalline limestones of the Lower Taconic were but the altered equivalents of this First Graywacke, and Rogers proclaimed, in 1851, that these crystalline limestones are "probably Upper Silurian or Devonian," while Edward Hitchcock, in 1861, conceived that they "may be as recent as the Carboniferous rocks."

The rocks of the same series have elsewhere been assigned to a still higher horizon. The schistose beds, though principally at the summit, are more or less interstratified with the underlying limestones and quartzites of the Lower Taconic, and in many places include besides limonite both magnetite and hematite. Important beds of these latter ores along both borders of the triassic series in Pennsylvania, embracing those of the Warwick and Jones Mines, of Reading, Boyerstown, Dillsburg, and Cornwall, were, by H. D. Rogers, in 1839, referred to the "middle secondary red sandstone" or trias, adjoining them; the peculiar characters of these crystalline schists being supposed to be due to "the metamorphism of the strata." In 1858, however, Rogers correctly referred them to the horizon of what he called the Primal Slates. Lesley, in 1859, while apparently accepting this latter view, refers with approval to those who regard these ores "as of middle secondary and not of primary age;" in accordance with which opinion the ores of Dillsburg are, by Frazer, in 1876, in his Report of the Second Geological Survey of Pennsylvania, described as mesozoic, and by McCreath, in his report for 1881, are also referred to the same horizon.

§ 31. The ground upon which J. D. Dana still defends the original position of Mather as to the horizon of the Lower Taconic crystalline limestones, while at the same time admitting the now unquestioned pre-Trenton and Cambrian age of the Graywacke series, is by supposing that the apparent succession of eastward-dipping strata in certain sections in this region represents their order of deposition, and, consequently, that the crystalline limestones are not below the Graywacke, as taught by Mather, but above it, and are apparently the altered representative of the Sparry Lime-rock. This, notwithstanding the caution of Emmons, he confounds with the Stockbridge or crystalline limestone of the Lower Taconic, and, therefore, from the organic remains, apparently of Ordovician age, found in the Sparry Lime-rock at the summit of the Upper Taconic, assigns the same age to the Lower Taconic limestone.

§ 32. In some parts of the great valley of Pennsylvania the Cambrian Graywacke or Upper Taconic had been removed from the Lower Taconic before the Ordovician age, and now appears only in isolated areas. In like manner, the Ordovician limestones are represented only by small portions of fossiliferous strata

resting upon the Lower Taconic, and probably also upon the Graywacke itself. Here also the gray Oneida-Medina sandstone is found in discordant superposition upon the Lower Taconic.

In regions outside of the great valley—to which the First Graywacke was apparently confined—are found many considerable areas of the Lower Taconic rocks, conspicuous among which are those early noticed in the Carolinas and in Georgia. Among these is a long range described and mapped by Maclure in 1817 as a "Transition belt." This is connected at its northern end with the same rocks in the great valley of Pennsylvania, and extends from the Delaware to the Yadkin River, beyond which, after a little interruption, it appears on the Catawba, and forms the King's Mountain belt in North and South Carolina; where these Lower Taconic rocks were described at length by the late Oscar Lieber as the Itacolumitic series. Without now referring to the other areas of these rocks in the Southern States, and to those which in New Jersey, Rhode Island, and Maine are found to the eastward of the great Appalachian valley, we may note the remarkable display of the same rocks at the mouth of the St. John River, in New Brunswick, and their reappearance in the Cobequid Hills, in Londonderry, Nova Scotia. To the westward, they are found on a considerable area in Hastings County, near the northern shore of Lake Ontario, where they were first described by the geological survey of Canada as the Hastings series.

§ 33. These rocks are largely developed around Lake Superior, where they were first recognized in northern Michigan by Houghton, and were described by Emmons in 1844, and again in 1855, as Taconic. They constitute the lower division of the Upper Copper-bearing series of Logan, and as seen on the north shore of the lake by the present writer were described as the Animikie series. These same rocks in northern Michigan have been, by Murray, Credner, and others, confounded with the Huronian, but the rocks of the Menominee district, including great deposits of iron ores and marbles, were, by Irving, in 1883, regarded as identical with the Animikie series, which the present writer, in 1884, referred to the Lower Taconic. These same rocks in northern Michigan were, in 1880, described by Rominger as part of a great system divided in ascending order into a Quartzite group (including a Marble series), an Iron-ore group, and an

Arenaceous Slate group, the rocks of all of which, from the descriptions, and the specimens which I have been permitted to examine, are apparently identical with the Lower Taconic as seen in Pennsylvania and elsewhere. This great system, according to Rominger, rests in some parts upon a gneissic and granitoid series (his Granitic group) and in others upon a great Dioritic group, chiefly of massive and schistose greenstones, with more or less chloritic varieties, and with closely associated serpentines, the whole group having the characters of the typical Huronian series. For many of the details respecting these rocks, elsewhere given more at length, I am indebted to the courtesy of Rominger in permitting me to consult his yet unpublished Report of the Geological Survey of Michigan for 1881–1884. It appears from a letter by Emmons to Marcou, dated December, 1860, and published by the latter in 1885, that its author had long before "claimed that the Huronian was only the Taconic system."

It is now evident that two widely distinct and stratigraphically discordant series have, around the basin of Lake Superior, been confounded under the common name of Huronian. It should, however, be said that their distinctness was noted by Logan as early as 1847, when he described the lower division (Animikie —Lower Taconic) of his Upper Copper-bearing group (its upper division being the Keweenian) as resting, on the north shore of Lake Superior, unconformably upon the ancient greenstone and chloritic group, to which the present writer, in 1855, first gave the name of Huronian, and of which fragments are there found in the basal beds of the Lower Taconic.

§ 34. Taconic (Lower Taconic) rocks, according to Emmons, are found near the Hot Springs of Arkansas, and probably occur elsewhere farther west at the base of the palæozoic. Many concordant observations show the existence of a similar series in Cuba, Trinidad, and Venezuela, and also in Brazil, where they constitute the Itacolumitic series, already compared by Oscar Lieber with that described by him in South Carolina. I have called attention to the presence in the Alps of a great series lithologically similar to the Lower Taconic, including the so-called lustrous schists or sericite schists, with granular marbles, anhydrite, quartzites, etc., as well displayed in the Mont Cenis tunnel and in the Apuan Alps. These crystalline rocks have

been by many European geologists regarded as altered strata of various ages, alike mesozoic and palæozoic, but are, in the opinion of Gastaldi, of Jervis, and many others, infra-Cambrian. Rocks lithologically and stratigraphically similar occur in Spain and in Norway, as I have elsewhere pointed out.

§ 35. It now became necessary to give distinctive terms to the two great groups of strata which, although originally separated by Eaton, were at first united by Emmons in one system, afterwards divided by him into Lower and Upper Taconic. It is unfortunate that the distinctive name of "Taconic slates" given by Emmons to the Upper Taconic division,—the First Graywacke or Cambrian,—solely for the sake of distinguishing it from the lithologically similar and often contiguous slates of the Second Graywacke or Ordovician (with which they had been confounded by his colleagues under the common name of Hudson River group), should have given rise to the false notion, entertained by some, that these Cambrian slates have a better title to the name of Taconic than the underlying Magnesian slate of Emmons—with its associated roofing-slate or Transition Argillite—and the still older crystalline limestones and quartzites; all of which were, together with the "Taconic slate" group, included from the first in the Taconic system of Emmons.

That the Taconic slate group or Upper Taconic was nothing more nor less than the Cambrian of the Appalachian valley has, we think, been made clear, and that the Lower Taconic is a wholly distinct and older series is also apparent. Its granular quartzites, often flexible; its crystalline limestones and dolomites, sometimes, like the quartzites, micaceous, and occasionally including amphibole and serpentine; its schistose beds, intercalated throughout, abounding in hydrous, non-magnesian micas, and occasionally carrying chlorite, talc, serpentine, garnet, and pyroxene; the presence also in the series of cyanite, staurolite, tourmaline, rutile, diamonds, and graphite; finally, the great included beds of magnetite, of hematite, and of siderite and pyrite, both yielding limonite by epigenesis,—all serve to show the existence of a peculiar and well-defined series of crystalline rocks, which are from four thousand to ten thousand feet in thickness, and are not less distinct from the uncrystalline Cambrian Graywacke or Upper Taconic than from those older crystalline series, the Laurentian, Arvonian, Huronian, and Montalban; upon each of which,

in different regions, it appears to rest in unconformable stratification. It is at the same time overlaid in New Brunswick by the Cambrian (Menevian) slates of St. John, and in very many parts of the Appalachian valley by the Cambrian Graywacke, and elsewhere in that region by the Silurian (Oneida) sandstone, and apparently by the Ordovician (Trenton) limestone, as is also the case in Ontario.

§ 36. It became evident to the writer after many years of study of these rocks, that the attempt to set aside this great factor in American stratigraphy,—already recognized by Maclure, by Eaton, and by Emmons,—and to regard it, in conformity with the fancies of the metamorphic school, alternately as altered Cambrian, Ordovician, Silurian, Devonian, Carboniferous, and even Triassic,—was, like similar attempts in British and in European geology, a grave error.

The distinctness and unity of this great series of crystalline stratified rocks being maintained, a name for it was needed, and that of Lower Taconic given by Emmons was at hand. His Upper Taconic had by himself, and by others, been recognized as the equivalent of what had been previously designated Cambrian, a name which it was thought it should henceforth bear. To prevent confusion in nomenclature, to secure uniformity in terminology, and to connect the name of Emmons with his great achievements in American stratigraphy, the writer, in 1878, proposed for the Lower Taconic the name of Taconian, which he has since adopted.

§ 37. These rocks, although below the recognized Cambrian horizon, and, unlike them, essentially crystalline, are not destitute of the evidences of organic life. There are many reasons, both direct and indirect, apart from the existence of Eozoon, for believing that "the dawn of life," as Dawson has happily called it, began long before Taconian time. The typical *Scolithus linearis* of the basic quartzites of the Taconian,—although, as I have long since pointed out, very distinct from the somewhat similar markings (probably of two or more distinct species) found in the Cambrian (Potsdam) of the Ottawa and Mississippi basins,—is the more significant from the fact that it is found throughout the Appalachian valley, and, moreover, that something very like it, if not identical, occurs in the Taconian limestone alike in Pennsylvania and in South Carolina, as well as in the Taconian quartz-

ites of Ontario. There also the limestones have yielded the remains of an organism, referred by Dawson to *Eozoon canadense*, filled not with a mineral silicate, as in the Laurentian serpentinic limestones, but with an earthy carbonaceous matter. To these should be added the occurrence of the remains of *Lingula*, found by Prime in the Taconian limestones of Pennsylvania, and of the remains of a keratose sponge in the argillite of this series, found by the writer in 1883 near Thomson, Minnesota. All of these facts (except the last) were insisted upon by the writer in 1876, and again in 1880, when in discussing the question whether the Taconian series is to be referred to eozoic or to palæozoic time, it was said that while to draw the line between them will be as difficult as to define that between palæozoic and mesozoic, or between mesozoic and cenozoic, "we may hope to find in the Taconic series a fauna which will help to fill the wide interval which now divides that of the eozoic rocks from the Cambrian;" adding that "we should seek in the study of stratigraphical geology not the breaks dividing groups from each other so much as the beds of passage which serve to unite all these groups in one great system."

§ 38. We have thus endeavored in the preceding pages to restate briefly the Taconic Question in some of its more important aspects. Further details, and the references to original sources, will be found in our recently published volume entitled "Mineral Physiology and Physiography," pp. 517–686. Therein appear the papers, published under the title of "The Taconic Question in Geology," in volumes i. and ii. of the "Transactions of the Royal Society of Canada in 1883 and 1884," in part rewritten and considerably augmented. In that volume will be found, on page 529, a tabular view (also published in the "Report on the Progress of Geology by the Smithsonian Institution for 1883"), wherein the stratigraphical sequence of the rocks of North America, including the Taconian series, and its relations alike to the older crystalline rocks below and to the First and Second Graywackes above, is shown to have been correctly indicated as early as 1832 by Amos Eaton, the preceptor of Ebenezer Emmons. Had the teachings of that great master in American geology been generally followed, it is not too much to say that a half-century of confusion, misconception, and controversy would have been avoided. It is the great merit of Emmons that he sought,

though unsuccessfully and amidst cruel opposition and injustice, to uphold those teachings, and to the best of his ability to extend the generalizations of Eaton; in a return to which, as we have at last learned, is to be found the solution of the vexed problem of American stratigraphy.

In the tabular view above noticed the writer attempted to introduce for the first time into American geology the term Ordovician, proposed by Lapworth in 1879 for the group of strata between the proper Silurian of Murchison and the undisputed Cambrian of Sedgwick, which, though by the latter named Upper Cambrian, has been alternately called by others Lower Silurian, Siluro-Cambrian, and Cambro-Silurian, and includes the Chazy, Trenton, Utica, and Loraine subdivisions of the New York system. This name of Ordovician has since been adopted by many British and European geologists, and is now used by Mr. Charles D. Walcott, of the United States Geological Survey, whose important generalizations regarding the American Cambrian, noticed in the above volume, pages 624, 625, are given at length in his recent work in 1886, entitled "Studies of the Cambrian Faunas of North America" ("Bulletin No. 30 of the Geological Survey"), and constitute a precious contribution to our knowledge of the North American Cambrian. His table of the succession of the Cambrian, with its subdivisions, and the Ordovician, will be found on page 44 of that Bulletin.[1]

[1] Since writing the above paper there has appeared in the *American Journal of Science* for February, 1887, an abstract by Mr. Walcott of a paper read by him in January before the Philosophical Society of Washington, in which he puts forth again, with but slight modifications, the old metamorphic hypothesis touching the Taconian rocks, as maintained by Mather, H. D. Rogers, and C. B. Adams, since resuscitated by J. D. Dana, supporting it apparently upon the assumption that certain white sandstones carrying Olenellus, found to the eastward of the Taconic Hills, are identical with the Primitive Quartz-rock of Eaton, the basal division of the Taconian. While entertaining the highest regard for Mr. Walcott's admirable work in palæontology, the writer can see in his published note no ground for revising the conclusions already set forth in the preceding pages.

HISTORY OF GARDEN VEGETABLES.

BY E. LEWIS STURTEVANT, A.M., M.D.[1]

(Continued from page 133.)

AUSTRALIAN SPINAGE (?). *Chenopodium auricomum* Lind.

A NATIVE of Australia, Darling River to Carpentaria and Arnheim's Land, a tall perennial herb furnishing a nutritious and palatable spinage.[2] It does not appear in any way superior to the Garden Orach, except, perhaps, for warm climates.[3] It is mentioned as under culture in England in 1867,[4] but it has apparently not yet become common or general.

BALM. *Melissa officinalis* L.

This aromatic perennial, a native of the Mediterranean countries, has long been an inmate of gardens for the sake of its herbage, which finds use in seasonings and in the compounding of liqueurs and perfumes, as well as the domestic remedy known as balm tea. The culture was common with the ancients, as Pliny[5] directs it to be planted, and as a bee plant or otherwise it finds mention in the Greek and Latin poets and the prose writers.[6] It is mentioned in France by Ruellius[7] in 1536; in England by Gerarde,[8] 1597, who gives a most excellent figure, and also by Lyte[9] in 1586, and Ray[10] in 1686. Mawe,[11] in 1758, says great quantities are cultivated about London for supplying the markets. In the United States it is included among garden vegetables by McMahon[12] in 1806.

As an escape the plant is found in England,[13] and sparingly in the Eastern United States.[14] Bertero[13] found it wild on the island of Juan Fernandez.

But one variety is known in our gardens, although the plant

[1] Director of the New York Agricultural Experiment Station, Geneva.

[2] Mueller, Sel. Pl., 1876, 49.

[3] Vilmorin, The Veg. Gard., 377.

[4] Gard. Chron., 1867, 1215.

[5] Pliny, lib. xxi. c. 41.

[6] Theocritus, Idyll., iv. 25; Dioscorides, iii. 118; Varro, iii. 16; Columella, ix. 9; Virgil, Georgics, iv.; as quoted by Grandsagne, Pliny, vol. xiii. p. 485.

[7] Ruellius, De Stirp., 1536, 733.

[8] Gerarde, Herbal, 1597, 558.

[9] Lyte, Dod., 1586, 293.

[10] Ray, Hist., i. 570.

[11] Mawe's Gard., 1758.

[12] McMahon, Am. Gard. Kal., 1806.

[13] De Candolle, Geog. Bot., 681, 721.

[14] Gray, Syn. Fl. of N. A., ii., Pt. i., 361.

is described as being quite variable in nature. This would indicate that cultivation had not produced great changes. The only difference I have ever noted in the cultivated plant has been in regard to vigor. A variegated variety is recorded by Mawe[1] in 1778 for the ornamental garden, and is yet to be found.[2]

The names which have been given in various languages are: English, *bawme*, Lyte, 1586, *baulm*, *balm*, Blackw., 1750; Danish, *hjertensfryd*, Vil., 1883; French, *melissa*, Ruel., 1536, *melisse*, Dod., 1616, *melisse citronnelle*, Vil., 1883; German, *Melissenkraut*, *Mutterkraut*, Lyte, 1586, *Citronem-Melisse*, Vil., 1883; Greek, *melissovotanon*, *melissohorton*, Sibth.; Holland, *consilie de greyn*, *melisse*, Lyte, 1586, *citroen-melisse*, Vil., 1883; Italy, *cedronella*, *herba rosa*, Lyte, 1586, *melissa*, Dod., 1616, Vil., 1883; Spain, *torongil*, *yerva eidrera*, Lyte, 1586, *torongil*, *citronella*, Vil., 1883.

Basella. *Basella* sp.

The Basella species are natives of tropical Asia, and the leaves have been employed as a food in India and China. They have furnished a spinage plant to European gardeners now for many years.

Basella alba L.

This species is cultivated in Burmah[3] for spinage, in the Philippines[4] seemingly wild and eaten by the natives. It is also cultivated in the Mauritius,[5] and in every part of India,[6] where it occurs wild.[7] It was introduced to Europe in 1688,[8] and was grown in England in 1691,[9] but these references can hardly apply to the vegetable garden. It is, however, recorded in French gardens in 1824 and 1829.[10]

The vernacular names in Europe are: English, *White Malabar Nightshade;* Flanders, *Meier;* France, *Baselle blanche*, *Epinard blanc de Amerique*, *Epinard blanc de Malabar;* Germany, *Indischer gruner Spinat*, *Malabar Spinat;* Italy, *Basella;* Spain, *Basela*.[11]

[1] Mawe, l. c.
[2] Les Fleurs de Pleine Terre, 13th ed., p 692.
[3] Mason, v. 472–780; quoted from Pick. Ch. Hist., 696.
[4] Blanco; quoted from Pick. Ch. Hist., 696.
[5] Bojer, Hort. Maurit., 1837, 270.
[6] Drury, Useful Plants of India, 66.
[7] Wight, ic., pl. 896.
[8] Noisette, Man. du Jard., 559.
[9] Mill. Dict., 1807.
[10] L'Hort. Franc., 1824; Noisette, l. c., 1829.
[11] Vilmorin, Les Pl. Pot., 30.

In the Mauritius, *gandolle blanc;*[1] in the Indian languages, Bengali, *sufed-pooin;* in Telinga, *allu-batsalla;* in Hindustani, *poi;*[2] in Burmah, *gyen baing*,[3] etc.

Basella cordifolia Lam. (*B. lucida* Lam.)

This species is cultivated in all parts of India,[3] and is the *Calalue* of Barbadoes.[4] It was imported from China to France in 1839,[5] and is now known under the name of *Baselle de Chine a tres larges feuilles.* Its greater expanse of leaves makes it more desirable as a spinage plant than the other species.

The vernacular names in India are: Bengali, *pooinshak;* Telinga, *pedda-batsella;* Hindustani, *pooi.*[6]

Basella nigra Lam.

This species is found in Cochin China and China, both wild and uncultivated,[7] and Livingston[8] says the leaves are much esteemed when boiled. It is very likely but a variety of the other species.

Basella rubra L.

This Indian species is cultivated as a spinage plant in many places. In 1638, according to the "Hortus Malabaricus," seed was sent from Ceylon to the botanic garden at Amsterdam,[9] and Ray,[10] in 1704, describes it as cultivated in gardens. No mention of it in kitchen gardens, however, occurs before the present century. It is mentioned in French works on gardening in 1824, 1826, and 1829,[11] and in the Mauritius in 1827.[12] Bretschneider[13] has found mention of it as a cultivated vegetable in Chinese authors of the sixteenth century, 1640, and 1742. Kaempfer describes it as a Japanese plant, and Rumphius as of Amboina.

The European names are: *Red Malabar Nightshade* in Eng-

[1] Drury, l. c.

[2] Pickering, Ch. Hist. of Pl., 696. Other names will be found in Birdwood, Veg. Prod. of Bomb., 177.

[3] Firminger, Gard. in Ind.; Drury, l. c.

[4] Maycock, Fl. Barb., 131.

[5] Vilm., l. c.

[6] Drury, l. c.

[7] Loureiro, Fl. Cochinch., 183.

[8] Livingston, Hort. Trans., v. 54.

[9] Mill. Dict., 1807.

[10] Ray, Hist. Suppl., 1704, iii. 358.

[11] L'Hort. Franc., 1824; Petit, 1826; Noisette, 1829.

[12] Bojer, l. c.

[13] Bretschneider, Bot. Sin., 59, 83, 85.

lish; in France, *Baselle rouge, Epinard rouge d'Amerique, Epinard rouge de Malabar;* in Germany, *Rother Malabar-spinat.*[1]

The extra European names I find are as follows: Mauritius, *bredes gandolle ou d'Angole;*[2] in Japan, *murasakki;*[3] in India, *poee sag;*[4] in Sanscrit, *pootika;* in Bengali, *racta-bun-pooi;* in Telinga, *yerra-batsalla;* in Ceylon, *rat-niwiti.*[5]

Basil. *Ocimum* sp.

Various kinds of basil have been grown in vegetable gardens since a remote period, for the sake of the aromatic foliage which serves as a seasoning. In 1778, Mawe names thirteen varieties, the broad-, narrow-, and fringed-leaved, the dark green, the large purple and the fringed purple, the tricolored, the curled- and the studded-leaved, the red- and the purple-flowered, the long-spiked and the short-spiked. At the present time Vilmorin describes ten kinds as serviceable for the kitchen garden. In 1612, "Le Jardinier Solitaire" devotes a section to directions for culture, and Quintyne, in 1693,[6] grew basil among hot-bed plants. According to Miss Bird,[7] the seeds are eaten in Japan.

Ocimum basilicum L.

This species is a very variable one, and furnishes a number of botanical varieties. It includes the large varieties of our gardens, in both the green- and purple-foliaged, the large-, medium-, and narrow-leaved. It is a native of tropical Asia, and is described for India by Drury, for Cochin China by Loureiro, for Amboinia by Rumphius, for Malabar by Rheede, etc. It was probably known to the ancients, but the commentators are often in doubt as to the name. Fee[8] thinks it the *okimon* of Hippocrates, Theophrastus, and Dioscorides, the *ocimum hortense* of Columella and Varro. It reached England on or before 1548, according to McIntosh;[9] certain it is, it is not mentioned by Turner in his "Libellus," 1538, and is well known to Lyte in 1586. It occurs in all the American works on gardening, commencing with 1806.

[1] Vilm., l. c.
[2] Bojer, l. c.
[3] Kaempfer, Amœn., 1712, 784.
[4] Speede, Ind. Handb. of Gard., 1842, 155.
[5] Birdwood, Veg. Prod. of Bomb., 177.
[6] Quintyne, Comp. Gard., 1693, 188.
[7] Unbeaten Tracks in Japan, i. 238.
[8] Fee, Notes in Grandsagne's Pliny.
[9] McIntosh, Book of the Gard., ii. 237.

In our synonymy we can include all the varieties named by Vilmorin as in present culture, and all those mentioned in the vernacular by less recent writers. A careful examination seems to justify the following attempts:

I.

Ocimum mediocre. Fuch., 1542, 548.
Basilica minor. Trag., 1552, 30.
O. parvum. Matth., 1558, 268.
O. medium vulgatius. Adv., 1570, 215; Lob. Obs., 1576, 268.
O. secundum. Cam., Epit., 1586, 309.
O. medium. Lugd., 1578, 680.
O. medium citratum. Ger., 1597, 547.
Basilicum medium. Hort. Eyst., 1613, Æst. ord., 7, fol. 9.
O. vulgaris. Bauh., Pin., 1623, 226.
? O. basilicum L. Sp., 2d ed., 833.
Basilic grand vert and *grand violet.* Vil., 1883, 31.
Sweet Basil and *Purple Sweet Basil.*

II.

Ocimum magnum. Fuch., 1542, 549.
Basilica major. Trag., 1552, 31.
O. max. caryophyllatum. Lob. Obs., 1576, 268; *ic.*, 1591, i. 503.
Ocimum. Cam., Epit., 1586, 308.
O. maximum. Lugd., 1587, 679.
O. garyophyllatum majus. Bauh., Phytopin., 1596, 425.
O. magnum. Ger., 1597, 547.
? O. basilicum, var. *b.* Lin., Sp., 2d ed., 833.
Basilic a feuilles large. De C., Fl. Fran., 1815, iii. 570.

III.

Ocimum anisatum. Hort. Eyst., 1613, Æst. ord., 14, fol. 2.
Basilic anise. Vil., 1883, 32.

IV.

Ocimum latifolium crispum. Matth., 1598, 408.
O. crispum viride. Hort. Eyst., 1613, Æst. ord., 7, fol. 10.
O. foliis fimbriatis viridis. Bauh., Pin., 1623, 225.
O. Sancto mauritanum. J. Bauh., 1651, iii. 249.

O. Basilicum L., var. *f.* Benth.
Basilic frise. Vil., 1883, 32.

V.

Ocimum latifolium magnum. Hort. Eyst., 1613, Æst. ord., 7, fol. 10.

O. viride foliis bullatis. Bauh., Pin., 1623, 225.

O. basilicum, var. d. Lin., Sp., 2d ed., 833.

O. bullatum. Lam. ex De C., Fl. Fran., III, 570.

Basilic a feuilles de laitue. Vil., 1883.

In the European languages Basil or Sweet Basil is called, in Denmark, *basilikum;* in Flanders, *basilik;* in France, *basilic grand, B. aux sauces, B. des cuisiniers, B. romain, herbe royale;* in Germany, *Basilicum,*[1] *Basilien, Basilgram;*[2] in Italy, *basilico;* in Portugal, *manjericao;*[3] in Russia, *wasilik;*[3] in Spain, *albaca, albahaca.*[1]

Outside of Europe it is called, in Arabic, *ryhan,*[4] *riban, habak;*[5] in Sanscrit, *manjirika;*[6] in Bengali, *barbooitulsee;* in Hindustani, *kala-tulsee, pashana cheddu;* in Tamil, *tirnoot-patchie;* in Telinga, *vepoodipatsa;*[7] in Persia, *deban-shab, nazbro, ungooshtkuneezuckan,*[6] etc.

Ocimum gratissimum L.

This species is recorded as indigenous from India, the South Sea islands, and Brazil.[8] According to Loureiro,[9] it occurs in the kitchen gardens of Cochin China. It was cultivated in England in 1752 by Mr. Miller.[10] Forskal[11] gives as the Arabic name, *hobokbok.* In French gardens[12] this plant is called *basilic en arbre.* Vilmorin thinks, however, that the French form may be the *O. suave* Willd., but of this he is not certain.

Ocimum minimum L.

This smaller species is a native of India, but is recorded from Cochin China and from Chili. From its compact form it is much grown in gardens, and has furnished several varieties. It is not

[1] Vilmorin, Les Pl. Pot., 31.
[2] Camerarius, Epitome, 1586, 308.
[3] McIntosh, Book of the Gard., ii. 238.
[4] Delile, Fl. Ægypt, illust.
[5] Forskål, Fl. Æg. Arab., c. xiv.
[6] Birdwood, Veg. Prod. of Bomb., 64, 241.
[7] Drury, Useful Pl. of Ind., 326.
[8] Mueller, Sel. Pl., 1876, 143.
[9] Loureiro, Fl. Cochinch., 369.
[10] Miller's Dict., 1807.
[11] Forskal, l. c.
[12] Vilmorin, l. c.

mentioned in Turner's "Libellus," 1538, and hence had probably not reached England at this time. It has been known in American gardens from the commencement of the present century, and probably earlier.

The synonymy can be established as below:

I.

Ocimum exiguum. Fuch., 1542, 547.

O. minimum amaraci figura caryophyllata. Adv., 1570, 215; Lob. Obs., 1576, 269.

O. caryophyllatus. Lugd., 1587, 681.

O. minus garyophyllatum. Ger., 1597, 547.

O. garyophyllatum. Matth., 1598, 407.

Basilico minore. Cast. Durante, 1617, 64.

O. minimum. Bauh., Pin., 1623, 226; J. Bauh., 1651, iii. 247; Ray, 1686, i. 541.

O. mimimum. L., Sp., 833.

Bush basil. Lyte, 1586; Ger., 1597; Ray, 1686; Burr, 1863.

Basilic fin, vert and violet. Vilm., 1883, 33.

II.

Ocimum min. caryophyllatum. Hort. Eyst., 1613, Æst. ord., 7, fol. 10.

Basilic fin vert compact. Vil., Alb. de Clich., n. 43077.

Compact Bush-basil. Vil., Veg. Gard., 1885, 19.

Bush basil is called in India *Sofed toolsee;*[1] in Italy, *Basilico gentile, Basilico garosonato;*[2] in France, *Basilic fin;* in Spain, *Albaca menuda, A. fina.*[3]

We certainly cannot find in basil an illustration of great modifications which have been produced by cultivation, nor can we suspect that there are any well-marked varieties of modern origination.

BEAN. *Phaseolus vulgaris* L.

When the bean was first known it was an American plant, and had a culture extending over nearly the whole of the New World, as it finds mention by nearly all the early voyagers and explorers, and while the records were not kept sufficiently accurate to justify identification in all cases with varieties now known, yet the

[1] Speede, Ind. Handb. of Gard., 184. [2] Cast. Durante, 1617.

[3] Vilmorin, l. c.

mass of the testimony is such that we cannot but believe that beans as at present grown were included. A partial list of such testimony I have given heretofore,[1] and hence it need not be repeated. The marvellous number of varieties known are indication of antiquity of culture, and when kept from crossing these varieties come true and perpetuate indefinitely characters which appear in the seed. From seed apparently on type, however, through atavism, other varieties may appear, and to one unfamiliar with the types might be considered as sports, and as proof of the variable nature of the plant.[2]

Commentators have quite generally considered this species as among the plants cultivated by the ancients, and De Candolle,[3] who has given the subject much thought, thinks the best argument is in the use of the modern names derived from the Greek *fasiolos* and the Roman *faseolus* and *phasiolus*. In 1542, Fuchsius[4] used the German word *Faselen* for the bean; in 1550, Roszlin[5] used the same word for the pea, as did also Tragus[6] in 1552. Fuchsius gives also an alternative named *welsch Bonen*, and Roszlin *welsch Bonen* and *welsch Phaselen* for the bean, and the same word, *welsch Bonen*, for the bean is given by Tragus, 1552, and Kyber,[7] 1553. This epithet, *welsch* or *foreign*, would seem to apply to a kind not heretofore known. Albertus Magnus,[8] who lived in the thirteenth century, used the word *faselus* as denoting a specific plant, as "faba et faseolus et pisa et alia genera leguminis," "cicer, faba, faseolus." He also says, "Et sunt faseoli multorum colorum, sed quodlibet granorum habet maculam nigram in loco cotyledonis." Now the *Dolichos unguiculatus* L. is a plant which furnishes beans with a black eye, as grown by me, and appears the same with many varieties of the "cow pea" of the Southern States, and is stated by Vilmorin to be grown in Italy in many varieties. I have before me, as I write, two hundred and nineteen bottles of beans, each with a distinct name (many, however, synonymes), and not one of these beans has a black eye. I have before me the seed of

[1] Kitchen Garden Plants of Am. Origin, Am. Naturalist, May, 1885, 448, 452.
[2] See Proc. of Am. Asso. for Adv. of Sc., 1885, xxxiv. 283.
[3] De Candolle, Orig. des Pl. Cult., 271.
[4] Fuchsius, De Hist. Stirp., 1542, 708.
[5] Roszlin, Kreuterbuch, 1550, 149.
[6] Tragus, De Stirp., 1552, 611.
[7] Kyber, Lexicon, 1553, 404.
[8] Albertus Magnus, De Veg., Jessen ed., pp. 118, 167, 515.

Dolichos unguiculatus and twelve named varieties of the cow pea, and all have a circle of black about the white eye, also one variety of cow pea all black, with a white eye, and one red speckled form without the black. It seems, therefore, reasonable to conclude that the *faselus* of Albertus Magnus was a Dolichos. In the list of vegetables Charlemagne ordained to be planted on his estates occurs the word *fasiolum*, without explanation.[1]

Passing now to the Roman writers, Columella[2] speaks of the "longa fasellus," an epithet which well applies to the pods of the Dolichos; he gives directions for field culture and not for garden culture, recommending the seeding to be four *modii per jugerum*, and he recommends planting in October. Pliny[3] says the pods are eaten with the seed, and the planting is in October and November. Palladius[4] recommends the planting of *faselus* in September and October, in a fertile and well-tilled soil, four *modii per jugerum*. Virgil's[5] epithet, "vilemque phaselum," also indicates field culture, as to be cheap implies abundance.

Among the Greek writers, Aetius,[6] in the fourth century, says the *Dolichos* and the *phaseolus* of the ancients were now called by all *lobos*, and by some *melax* (smilax ?) *kepea*. This word *lobos* of Aetius is recognizable in the Arabic *loubia*[7] applied to *Dolichos lubia* Forsk., a bean with low stalks, the seed ovoid, white, with a black point at the eye. Galen[8] says the *lobos* was called by some *phasiolos*.

From these and other clues to be gleaned here and there from the Greek authors, I am disposed to think that the low bean of the ancients was a Dolichos, and that the word *phaselus* referred to this bean whenever used throughout the middle ages in speaking of a field crop.

The Roman references to *phaseolus* all refer to a low-growing bean fitted for field culture, and so used. There is no clear indication to be found of garden culture. Aetius seems the first among the Greeks to refer to a garden sort, for he says the *lobos* are the only kind in which the pod is eaten with the bean, and

[1] Quoted from De Candolle, Orig. des Pl. Cult., 272.
[2] Columella, lib. x. l. 378; lib. ii. c. 10; lib. xi. c. 2.
[3] Pliny, lib. xviii. c. 33. [4] Palladius, lib. x. c. 12; lib. xi. c. 1.
[5] Virgil, Georgics, i. 227. [6] Quoted by Bodæus a Stapel, Theophrastus, 1644, 925.
[7] Delile, Mem. sur les Pl. cult. en Egypte, 24.
[8] Galen, De Aliment, c. xxviii.

he says this *lobos* is called by some *melax kepea* (smilax hortensis), the *dolichos* and *phaseolus* of his predecessors. Galen's use of the word *lobos*, or the pod plant, would hence imply garden culture in Greece in the second century.

The word *loubion* is applied by the modern Greeks to the *Phaseolus vulgaris*, as is also the word *loba* in Hindustani. The word *lubia* is applied by the Berbers, and in Spain the form *alubia* to the *Phaseolus vulgaris*.[1] The words *fagiuolo* in Italian, *phaseole* in French, are used for the *P. vulgaris*. It is so easy for a name used in a specific sense to remain while the forms change, as is illustrated by the word squash in America, that we may interpret these names to refer to the common form of their time, to a Dolichos (even now in some of its varieties called a *bean*) in ancient times and to a Phasiolus now.

Theophrastus[2] says the *dolichos* is a climber, and bears seeds, and is not a desirable vegetable. I find no other mention of a climber in the ancient authors. The word *dolichos* seems to be used in a generic sense. Theophrastus says *the his dolichos*, the intensive *s* being used after the *o;* but the *dolichos* of Galen is the *faselus* of the Latins, for he says that some friends of his had seen the *dolichos* (a name not then introduced at Rome) growing in fields about Caria, in Italy. We may hence be reasonably certain that the pole beans which were so common in the sixteenth century were not then cultivated.

The English name *kidney beans* is derived evidently from the shape of the seed. Turner, 1551, is the first use of this name I note; but they were not generally grown in England until quite recent times. Parkinson, in 1629, speaks of them as oftener on rich men's tables, and Worlidge, in 1683, says that within the memory of man they were a great rarity, although now a common delicate food. The French word *haricot*, applied to this plant, occurs in Quintyne,[3] 1693, who calls them *aricos* in one place, and *haricauts* in another. The word does not occur in "Le Jardinier Solitaire," 1612, and Champlain,[4] in 1605, uses the term *febues du Bresil*, indicating he knew no vernacular name of closer application. De Candolle[5] says the word *araco* is Italian,

[1] De Candolle, Orig. of Cult. Pl., 278.
[2] Theophrastus, c. 3. Bodæus a Stapel, 1644, 914.
[3] Quintyne, Comp. Gard., 1693, 185, 142.
[4] Champlain, Voy. Prince Soc. Ed., 64. [5] De Candolle, Orig. of Cult. Pl., 274.

and was originally used for *Lathyrus ochrus*. It is apparently thus used by Oribasius and Galen.

The two species of Linnæus, *Phaseolus vulgaris* and *P. nana*, correspond to the popular grouping into pole and dwarf beans. But there is this to be remarked, that Linnæus synonymes for *P. nana* apply to a Dolichos, and not to a Phaseolus, for the descriptions of *Phaseolus vulgaris italicus humilis s. minor, albus cum orbita nigricante* of Bauhin's[1] history answer well to the cow pea, as also does C. Bauhin's[2] *Smilax silique sursum rigente s. Phaseolus parvus italicus*, and do not apply to the bush bean. The figures given by Camerarius[3] in 1586, by Matthiolus,[4] 1598, and by Bauhin, 1651, are all cow peas, although the names given are those used for the true bean, thus indicating the same confusion between the species and the names which kept pace with the introduction of new varieties of the bean from America, for Pena and Lobel,[5] in 1570, say that many sorts of *fabas Phaseolosve* were received from sailors coming from the New World.

Phaseolus nana L.

The first figure I find of the bush bean is by Fuchsius,[6] in 1542, and his drawing resembles very closely varieties that may be found to-day,—not the true bush, but slightly twining. In 1550, Roszlin[7] figures a bush bean, as does Matthiolus[8] in 1558, Pinæus[9] in 1561, and Dalechamp[10] in 1587. Matthiolus says the species is common in Italy, in gardens, and oftentimes in fields, the seed of various colors, as white, red, citron, and spotted. Dalechamp figures the white bean. The dwarf bean is not mentioned by Dodonæus[11] in 1566 nor in 1616. A list of varieties cultivated in Jamaica is given, in 1837, by Macfadyen,[12] which includes the one-colored black, yellow, red, etc.; the streaked, in which the seeds are marked with broad, linear curved spots; the variegated, the seeds marked with rubiginose, leaden, etc., more or less rounded spots; and the saponaceous, with the back of

[1] Bauhin, Hist., 1651, ii. 258.
[2] Bauhin, Pin., 1623, 339.
[3] Camerarius, Epit., 1586, 212.
[4] Matthiolus, Op., ed. Bauhin, 1598, 341.
[5] Pena and Lobel, Adversaria, 1570, 394.
[6] Fuchsius, De Stirp., 1542, 708.
[7] Roszlin, Kreuterbuch, 1550, 149.
[8] Matthiolus, Comm., 1558, 237.
[9] Pinæus, Hist. Plant., 1561, 140.
[10] Hist. Gen. Lugd., 1587, 472.
[11] Dodonæus, Frument., 1566.
[11] Dodonæus, Pempt., 1616.
[12] Macfadyen, Jam., i. 283.

the seeds white, the sides and concavity marked with spots so as to resemble a common soap-ball.

Gerarde,[1] 1597, does not mention this bean in England, but it is mentioned by Miller,[2] in 1724, in varieties which can be identified with those grown at the present time, five in all. In 1765, Stevenson[3] names seven varieties; in 1778, Mawe[4] names eleven. In 1883, Vilmorin[5] describes sixty-nine varieties and names others.

Phaseolus vulgaris L.

Pole beans are figured by Tragus[6] in 1552, who speaks of them as having lately come into Germany from Italy, and he calls them *welsch* or foreign, and he enumerates the various colors, as red, purplish white, variegated, white, black, and yellowish. Dodonæus[7] in 1566 and 1616 figures the pole bean, as does Lobel[8] in 1576 and 1591, Clusius[9] in 1601, and Castor Durante[10] in 1617. In 1597, Gerarde[11] figures four varieties in England, the white, black, red, and yellow, and Barnaby Googe[12] speaks of *French beans* in 1572, indicating by the name the source from which they came. In 1683, Worlidge[13] names two sorts as grown in English gardens, and the same varieties are given by Mortimer[14] in 1708. In France, in 1829, nineteen sorts are enumerated by Noisette,[15] and in 1883, Vilmorin[16] describes thirty-eight varieties and names others.

The bean is called in England *kidney bean*, Turner, 1551, Vilm., 1883; *French bean*, Vil., 1883; *sperage bean*, Ger., 1597, Googe, 1572; *faselles*, *long peason*, *garden smilax*, *Romane beans*, Lyte, 1586; in Denmark, *havebonnen*, Vilm., 1883; in Flanders, *boon*, Vilm., 1883; in France, *febues*, Cartier, 1536, *fasiolis*, Pin., 1561, *haricot*, Quint., 1693, Vilm., 1883, *phaseole*, Vilm., 1883; in Germany, *welsch Bonen*, Fuch., 1542, *Bohne*, Vilm., 1883; in Greece, *fasoulia*, De C., 1883; in Holland, *boon*, Vilm., 1883; in

[1] Gerarde, Herbal, 1597, 1038.
[2] Miller's Dict., 1807.
[3] Stevenson, Gard. Kal., 1765, 66.
[4] Mawe, Gard., 1778.
[5] Vilmorin, Les. Pl. Pot., 250.
[6] Tragus, l. c.
[7] Dodonæus, l. c.
[8] Lobel, Obs., 1576, 511; ic., 1591, ii. 60.
[9] Clusius, Hist., 1601, ii. 222.
[10] Castor Durante, Herb., 1617.
[11] Gerarde, Herbal, 1597, 1038.
[12] Gard. Chron., 1864, 1181.
[13] J. W. Gent., Systema-Hort., 1683, 197.
[14] Mortimer, The Whole Art of Husbandry, 1708, 456; quoted from Gard. Chron., 1864, 1013.
[15] Noisette, Man., 1829, 361.
[16] Vilmorin, l. c.

Italy, *fagiuolo*, Pin., 1561, Vilm., 1883; in Portugal, *feijao*, Vilm., 1883; in Spain (in Castile), *arvejas luengas*, (in Aragon) *judias*, Oviedo, 1546, *faxones fexoes*, *frejoles*, Navarette, about 1500, *fasiolos*, Cam., 1586, *habichuela*, *judia*, *frijol*, Vilm., 1883; in Sweden, *Turkiska boner*, Tengborg, 1764.

In India, in Hindustani, *bakla*, *loba*; in Ceylon, *dambala*, Birdwood; in Cochin China, *dau tlang*, *tau*, Lour.

In America, the Northern Algonquins, *tuppuhquam-ash*,—*i.e.*, twiners, Elliott; in Carib, *calaouana*, Breton's Dict.; in Chahta, *tobi*, Gray; in Chippeway, *miskodissimin*,—*i.e.*, red-dyed seed, Gray; in Dakota, *onmnicha*, Gray; in Delaware, *malachxit*, Zeisberger; in Huron, *ogaressa*, Sagard; in Kennebec Abnaki, *a'teba 'kive*, Rasle; in Mohawk, *osaheta*, Gray; Mojave, *se-vau*, Whipple; in the Narragansett, *monasquisset* (singular), Cotton, *manusqussed-ash* (plural), R. Williams; in Onondaga, *onsahita* and *hosahita*, Shea; in Pequod, *mushquissedes*, Stiles; in Peru, *purutu*, de Vega; on the St. Lawrence, *sahe*, Cartier; the Shawanoes of Ohio, *m'skochi-tha*, Gray; the Cheyenne, *monisk* or *monehka*, Hayden; in Virgina, *okindjier*, Haricot, *peccatoas*, *peketawes*, Strachey;[1] Yuma, white beans, *marique*, Whipple.

In Mexican, *etl* of the Aztecs; when boiled in the green pod *exotl*, Bancroft.

It should not be overlooked that this bean has been found in the ancient Peruvian tombs at Ancon;[2] that Verarzanus,[3] an Italian, in 1524, previous to the recorded introduction of the bean to Italy, in describing those met with on the New England coast, says, "differing in colour and taste fro' ours, of good and pleasant taste;" and Harriot,[4] in 1586, when kidney beans were scarcely in general culture in England, notes in Virginia that the beans are different from those of England in that they are "flatter, of more divers colours and some pied. The leaf also of the stem is much different."

[1] These Indian names mostly taken from Gray and Trumbull, Am. Jour. of Sc., August, 1883.

[2] Stevenson, Trav., i. 328; De Candolle, Orig. des Pl. Cult., 273.

[3] Verarzanus, Hakluyt, Divers Voy. to Am., 60.

[4] Harriot, Pink. Voy., xii. 595.

(To be continued.)

METSCHNIKOFF ON GERM-LAYERS.[1]

TRANSLATED BY H. V. WILSON.

SOME of the most fundamental principles of the comparative embryology of to-day can be traced back, with a greater or less change of form, to the beginning of the century. Among such is the idea embodied in the following law, which was enunciated by the school of natural philosophers in Germany: "The evolution undergone by every animal from the beginning of its life corresponds to the evolution which is to be observed in the series of animals." The law as thus stated met with opposition from Von Baer (1),[2] who maintained that the embryonic stages of an animal are by no means to be compared with other adult forms, but with the embryos of these forms. He had finally to admit, however, that the difference between these two views is not nearly so great as it appears to be at first sight.

Already animated by this philosophical generalization, embryology received a great stimulus from the parallel Louis Agassiz drew between the embryonic stages of existing animals and the main stages in the geological development of the animal kingdom. Agassiz himself failed to make the right deductions from this truth.

While students of embryology were thus engaged in looking for general points of similarity, on the one hand, between embryonic stages of animals and existing adult forms, and between embryos and extinct animals on the other, Huxley, in 1849, instituted the comparison between the germinal layers of Vertebrates and the layers of the Cœlenterate type. To the latter he gave the names of ectoderm and endoderm. This idea did not remain unnoticed in England, but was generalized and given a popular character by Herbert Spencer in one of his beautiful essays, entitled "The Social Organism." Let me quote from the English philosopher: "Throughout the whole animal kingdom, from the Cœlenterata upward, the first stage of evolution is the same. Equally in the germ of a polype and in the human ovum, the aggregated mass of cells out of which the creature is to

[1] The following paper forms the closing chapter of Professor Elias Metschnikoff's "Embryologische Studien an Medusen," Wien, 1886.

[2] The numbers in this article refer to the bibliographical list appended.

arise, gives origin to a peripheral layer of cells, slightly differing from the rest which they include; and this layer subsequently divides into two,—the inner, lying in contact with the included yelk, being called the mucous layer, and the outer, exposed to surrounding agencies, being called the serous layer: or, in the terms used by Professor Huxley in describing the development of the Hydrozoa, the endoderm and ectoderm. This primary division marks out a fundamental contrast of parts in the future organism." The share each layer takes in building up the developing animal is then touched upon, after which the author proceeds to draw an analogy between the layers of an animal body and the grades of society, in which he compares the ectoderm with the higher grades, the endoderm with the lower grades, and the mesoderm with *tiers-état.*

Huxley's theory for a long time found no supporters in Germany. In that country there was noticeable a certain reaction against the general application of the doctrine of the germinal layers. This reaction reached its greatest height in the well-known paper by Weismann on the embryology of the Diptera. Such a tendency was in perfect accord with the doctrine of types then prevalent, according to which morphological comparisons could only be made within the limits of one and the same great group.

The similarities in the structure and development of animals were long regarded as the expression of a universal plan, which was of a purely ideal nature. In the last two decades it has been generally recognized that at the bottom of these similarities lies genetic relationship. The value of embryology as a key to this relationship was recognized by Darwin, who laid special emphasis on the view that the embryo, being less differentiated than the adult, ought to afford us valuable information concerning the structure of its ancestors; and that when the embryos of two animals are alike, the similarity is due to a common descent. He attempted to illustrate these general laws by concrete examples, and where he met exceptions, he explained them by supposing the embryonic record to be obscured by larval adaptations and precocious inheritance. Darwin thus came to the conclusion that the parallel Agassiz had pointed out is due to the blood relationship of animals, and that this parallel is thoroughly revealed only in cases where the process of develop-

ment has not been altered by the introduction of any obscuring disturbance.

The embryological principles of Darwin were developed in a deductive manner by Fritz Müller in his important little book, "Für Darwin," and were illustrated by many facts chosen from the life histories of the lower animals. The way Müller looked at his facts revealed the manner in which the problems of comparative embryology must be approached in future. He especially emphasized his belief that individual development only repeats genealogical development in cases where the descendants (in the course of their embryology) travel without swerving the straight path which leads up to their ancestral form, "where, however, they do not stop, but press farther on." "In the short space of a few weeks or months," says Müller, "the ever-altering forms of the embryos and larvæ present to our eyes a more or less perfect picture of the changes through which, in the course of countless ages, the species has struggled up to its present condition." In connection with Darwin's ideas on the disturbance of the developmental process, Müller formulated this proposition: "The historical record preserved in the development of the individual is gradually lost, since there is always at work a tendency to make the path from the egg to the adult as straight as possible. The record is, moreover, falsified because of the struggle for existence in which the larvæ that lead an independent life have to take part."

This book of Müller's marked an epoch; and in part under its influence there was soon begun a very active overhauling of the facts of animal embryology, in which more attention was paid to the lower animals than to the higher Vertebrates. Independently of this movement, Kölliker, in 1865 (in the second part of his "Icones Histologicæ," p. 90), came to certain general conclusions, which essentially coincided with the views of Huxley. "Whatever the cause may be," says Kölliker, "the uniformity in structure of a Hydrozoan and a young Vertebrate embryo is a very striking fact; and if this question is pursued further with an eye to the structure and histological development of many animals, it is pretty certain that some simple law of development will be discovered. The problem was before long a subject of busy investigation. The forsaken theory of the germinal layers was again taken up in the realm of the Invertebrates,

and was enriched with many fresh facts, so that it soon became the password to the new road upon which embryology had entered. The theory received the greatest impulse from Kowalevsky's discovery of the development of Amphioxus (2). The embryology of this animal disclosed phenomena which linked together the development of Vertebrates and Invertebrates. As soon as Kowalevsky had discovered the two-layered ciliated larva of Amphioxus he began to look for analogous embryonic forms in other animals, and succeeded in establishing a great number of very valuable facts. These investigations, having for their object the discovery of the most fundamental embryonic forms, such as might be compared with the early stages of Amphioxus, were naturally followed out on animals of low grade with simply organized larvæ. On the other hand, I turned my attention to the development of the higher Invertebrates, with the design of establishing here also the germ-layer theory. I first studied the embryology of Sepiola (4), found two germinal layers, and observed the part each played in building up the organism. Following up the investigation in the group of Arthropods, I failed to demonstrate satisfactorily the germinal layers in Insects, but found them in the higher Crustacea (5) (Nebalia), and particularly well in the scorpion (6). In the latter animal I at first (1866) found only two layers, but soon after (1868) discovered the third. I showed in the scorpion that the upper layer gives rise to the central nervous system; that the middle splits into two layers and forms a series of hollow segments, by the fusion of which the body cavity arises; and that, finally, the under layer becomes the lining membrane of the alimentary canal. Supported by these facts, I concluded, in 1869 (in a publication of the Educational Bureau), that the three layers of the scorpion embryo corresponded in all respects to the three Vertebrate layers. I was not deterred from this view by my belief at the time that the nerve-fibres were derived from the middle instead of the upper layer, since the peripheral nervous system of the Vertebrates was then generally considered to be mesoblastic. Thus the problems of comparative embryology were attacked on two sides, with the object of getting a good basis of facts. It was not until I had made out the main features in the formation of the germinal layers of the scorpion that Kowalevsky began to investigate the embryology of the Oligo-

chæta and Insecta (3). He found in these animals the same three layers, and carefully studied their changes. The rejuvenated germinal-layer theory had now gained a firm basis in the domain of the Invertebrates, and comparative embryology took a new direction, mainly under the guidance of German and Russian investigators. Since the idea of the germinal layers was taken from the higher animals, and was then applied to the Invertebrates, it was natural that misconceptions should arise, owing to such an anti-genealogical method. Some of these misconceptions have lasted until to-day; for instance, in cases where the determination of the several layers is beset with doubt there is often too much stress laid upon purely topographical characteristics. The Orthonectidæ and Dicyemidæ afford two such cases. In these animals certain cells, whose function is generative, are styled endoderm, merely because they lie beneath the external layer. Ed. van Beneden (14, 15) goes so far as to consider the topographical position as the one guide in determining the germinal layers. To quote his own words: "We designate as endoderm the layer or mass of cells which is enclosed, whatever be the tissues derived from it." Haeckel must in this respect be accredited with having made an important step forwards, when he sharply formulated the view, according to which the germinal layers, or at least the two chief layers, are to be regarded as primitive organs (16). From this stand-point a structure in question could only be called endoderm when it possessed several characteristics of this primitive organ, and not when it merely agreed with the organ in topographical position. If, for example, the enclosed mass of cells in the Orthonectidæ were digestive in function there would be no doubt that they represented an endoderm; but since the cells in question are sexual cells, there is very considerable doubt. The main difficulty in the determination of the layers is due to the fact that the genealogy of the germinal layers does not rest on a safe basis, since we know nothing of the primitive condition of the Metazoa. To get an idea of their original condition one must frame hypotheses, such as coincide with as many facts as possible. From a mere hypothesis the doctrine of descent grew to a stable theory as soon as it was shown what a number of phenomena were explicable with its aid and that no fact contradicted it. In like manner hypotheses, which seek to elucidate the original condition

of the above-mentioned primitive organs, should only be given the rank of theories when they are in harmony with our actual knowledge.

The transitional stages between the Protozoa and Metazoa do not appear to exist at the present day. Endeavors have been made, however, to fill this gap in our knowledge by means of hypothetical organisms. There are two ways possible for such a transition to take place,—either by a differentiation of protoplasm around the separate nuclei of a multinucleate protozoan, or by the union of the several individuals of a protozoan colony into a many-celled individual. We will discuss the former method of transition first, and then take up the latter. A close relationship was some time ago supposed to exist between the ciliate Protozoa on the one hand, and the Turbellarians on the other, especially the larvæ of the latter. On the supposed kinship between the two groups there have been built up hypotheses relating to the descent of the Metazoa. Such hypotheses have as their kernel the transition of multinucleate Protozoa into Metazoa, and have been adopted by several investigators, among whom we must mention Jehring (19) and Saville Kent (20). From the stand-point here taken, the mouth and anus of the Infusoria are homologous with the like organs in the Metazoa. Indeed, Jehring believes that the water vascular system of the latter has been derived from the contractile vesicle of the Protozoa. Looking over the whole field of embryology, we find the formation of the blastoderm in Insecta to be the process most in accord with this hypothesis. It is, in fact, on the first stages in the development of the Aphides that Kent mainly rests his belief. Considerations of this kind clearly show that such a hypothesis cannot be maintained. While ignoring all the embryological facts of the lowest Metazoa, the theory harmonizes with the formation of the blastoderm in the Insecta; that is, in a group which has suffered in every respect great secondary changes. But even in this group there are forms that contradict the hypothesis, as, for example, the Poduridæ, insects which in other respects occupy the lowest position in the class, and agree in the segmentation of the egg with Myriapods. When the facts are these, no value can be ascribed to the homologies drawn between the mouth, anus, and water vascular system of the Infusoria and Metazoa.

On the other hand, the hypothesis which supposes that colo-

nies of flagellate Infusoria were transformed into primitive Metazoa explains very clearly the most important phenomena of metazoan development. On this view the segmentation of the egg, and especially the more primitive total segmentation, has been derived from the division which the Flagellata undergoes in building up a colony. In like manner the fact that the cells of so many blastospheres are ciliated is probably due to inheritance from the Flagellata. This hypothesis forbids our homologizing the mouth and other "organs" of the Protozoa with the like parts of the Metazoa, but on the other hand enables us, as Bütschli (21) first pointed out, to comprehend the origin of sexual multiplication. As a fact most embryologists, Ray Lankester and Balfour among others, have adopted this second hypothesis, and after a prolonged trial it has become a basis for further speculations.

Having progressed this far, we should ask ourselves whether it is not possible, with the help of our present knowledge, to determine more or less exactly the nature of those Flagellate colonies from which the Metazoa are descended. Bütschli (22) believes the Metazoa have had a double origin,—the Sponges he derives from colonies of the Choano-Flagellata, the rest of the Metazoa from colonies of true Flagellata. Aside from the fact that there is very little ground for such a venturesome assumption, we must remember that the two groups (of Flagellata) are not sharply separated, and that the collar, which constitutes the main point of difference, is in some cases entirely retracted. As to the relationship of the Sponges to the Cœlenterates, I shall have a word to say farther on.

Whether the Flagellata from which the Metazoa are descended had a collar or not, they were certainly able to take in solid bits of food. This is to be inferred from the great prevalence of intracellular digestion among the lower Metazoa. Taking into account this characteristic of the Metazoa-Flagellata, I cannot believe with Bütschli that the process of nutrition is not worth considering in connection with the question of the metazoan descent. Bütschli is of this mind "because the physiology of nutrition varies exceedingly in the group of Flagellata, without regard to the morphology" ("Remarks on the Gastræa Theory," p. 417). I believe, on the contrary, that the further differentiations undergone by the ancestral colonies were by no means

independent of the method of nutrition. While in some colonies vegetable pigments were found to assist the process of assimilation, others, retaining the method of animal nutrition, gave rise to individuals whose special function it was to seize and digest food. That this conclusion is not purely deductive is gathered from a comparison of such Flagellate colonies as the Volvocineæ and Protospongia.

It would be much to the interest of further deductions if we possessed some actual knowledge of the development of these hypothetical colonies. That they must have been propagated sexually is clear from the multiplication of Volvox. Indeed, the existence of sexual multiplication is a strong argument in favor of the descent of the Metazoa from the Flagellata. As regards a sexual multiplication, the existing Flagellata divide and exhibit some variety in their division. The true Flagellata divide for the most part longitudinally, but transverse division occurs in some species, for example in *Phalansterium consociatum* according to Cienkowsky (24), and in *Ph. digitatum* according to Stein (25). In the Choano-Flagellata, also, both kinds of division have been observed, even in closely-related forms. Thus, according to Kent, *Salpingœca campanula* suffers longitudinal division (20), while all the other species of this genus divide transversely. "The simultaneous occurrence of longitudinal and transverse division in one and the same form has, however, been hitherto established only for certain Chlamydomonadinæ (23). Since in animals that build up colonies the division of the individual plays an important part in determining the shape of the stock, it is important to learn how the hypothetical Metazoa-Flagellata behaved in this respect. Let us recall the generalization made in the second chapter, that the first three planes of segmentation lie in the three dimensions of space. We found this to be true for Medusæ that suffer totally different developments (for hypogenetic as well as metagenetic Medusæ, and regardless of the various ways of forming the endoderm, etc.); and it holds for animals in general, however different they may be, that undergo total segmentation. We are therefore justified in assuming that the same kind of division prevailed among the ancestors of the Metazoa. There is the more reason for this assumption in view of the many ways in which it is possible for an embryo to be built up, of which an idea may be obtained from plants and ani-

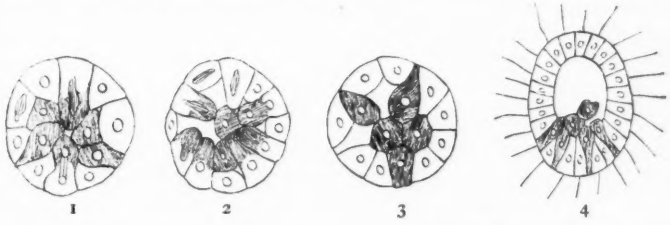
mals with unequal segmentation. Even the formation of a blastosphere can take place without the occurrence of the typical first three divisions. Thus, in Volvox, all the divisions are meridional, the result being a plate-like embryo resembling Gonium. There is no segmentation cavity, and the blastocœle is formed by the gradual growth of the plate towards one pole (22, 23, 25). If we are to use the process of segmentation at all for genealogical purposes, the assumption adopted above seems inevitable. It is, moreover, not without the support of analogous cases in the organic world, as is learned from the divisions undergone by the Schizomycetes. Most of these forms divide transversely, but there are a few exceptions with longitudinal division, for example, a peculiarly branched species parasitic in *Daphnia pulex*, discovered and described by me as *Dendrobacterium oculatum*. Besides such bacteria where there is but one kind of division, there are others where the cells divide in two meridional planes, as in the micrococci of gonorrhœa; and yet others like Sarcina, where the divisions follow the three dimensions of space and consequently agree with the total segmentation of most Metazoa, and also with the assumed division of the hypothetical Metazoa-Flagellata. Since in the typical cases of total segmentation the segmentation cavity appears after the third division, and the embryo is very early transformed into a blastosphere, it is probable that the ancestors of the Metazoa swam about as blastosphere-like colonies.

If we accept these peculiarities of the Metazoa-Flagellata as a basis for further speculations, we are enabled, it appears to me, to throw a certain light on the origin of the primitive organs. Embryology teaches us that the endoderm is formed in very different ways among the Medusæ. In recapitulating these various methods, I have first to state that the endoderm arises either at several points of the embryo or only at one point. In the first case the origin is multipolar, in the second unipolar (in the latter the pole is always at the hinder end of the larva). The multipolar type of formation appears either (*a*) as a multipolar immigration of the cells from the surface of the blastosphere into the interior; (*b*) as a primary delamination by means of the transverse division of the cells of a blastosphere; (*c*) as a secondary delamination following upon the formation of a morula; or (*d*) as a mixed delamination, where the endoderm is in part

formed by transverse division and in part by immigration. These methods of forming the endoderm are not all sharply separated; on the contrary, transitions exist between some of them. The unipolar type appears either (*a*) as an immigration of the blastula (or blastosphere) cells from the hinder end of the larva, or (*b*) as an invagination.[1]

The question is now, What is the stand-point from which a comprehensive and intelligible view may be got of these various methods of forming the endoderm, and which of the existing theories on the origin of the primitive organs is best able to explain the facts? It is at once seen that on assuming the descent of the Metazoa from multinucleate Protozoa (Infusoria, or perhaps Heliozoa and Radiolaria), we become entirely unable to explain either immigration from the surface, or primary delamination, or invagination. It is unnecessary for me to go into a detailed criti-

[1] Multipolar immigration is illustrated by Fig. 3. From various points of the blastula cells migrate into the interior; and, their number increasing, they here form a solid mass of endoderm, which is subsequently hollowed out to form the digestive cavity. This method occurs in Æginopsis (Atlas to the original paper, Plate IX.). Fig. 2 illustrates primary delamination, found in the Geryonidæ (Atlas, Plates V. and VI.). The inner ends of the blastula cells are constricted off to form the endoderm. They very soon arrange themselves in the shape of a hollow sphere, the cavity of which becomes the permanent digestive cavity. Secondary delamination is the rule



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among Hydroids without a free medusa stage. It is essentially like mixed delamination, Fig. 1, but differs from it in the very late appearance of any histological difference between the superficial layer of cells and the included or endoderm cells. Neither in this type nor in mixed delamination is there an obvious blastosphere, the cell immigration and transverse division commencing at a very early date. In both types the solid endoderm is subsequently hollowed out to form the digestive cavity. Mixed delamination is found in *Polyxenia leucostyla* (Atlas, Plate VIII.). Unipolar immigration is illustrated by Fig. 4. It is the rule with metagenetic Hydromedusæ. The immigration continues until the central cavity is filled with a solid endoderm, which afterwards is hollowed out (Atlas, Plates II., III., IV.). Invagination has hitherto only been found in the Acraspeda (Nausithoe, Pelagia, Plate X., Atlas).—*H. V. W.*

cism of this hypothesis, which can lead us nowhere, and which must therefore be rejected.

The Gastræa theory, as is well known, has rendered great service in reducing the different phenomena of development to a primary invagination; it very often simplifies the complicated appearances sometimes seen in the formation of the endoderm, for instance, in the Vertebrates. But it is when the theory is called upon to explain delamination that it finds itself in the midst of difficulties of which Haeckel was aware when he first formulated his views on this subject. "The greatest cause for doubt," said he in his monograph on the "Calcareous Sponges" (vol. i. p. 467), "seems to lie in the fact that the gastrula may come from the morula by two quite different roads. In the one case it arises by a central hollowing out of the morula, the gastric cavity thus formed breaking through to the exterior. In the other case a blastosphere is formed, a hollow sphere whose wall consists of a single layer of cells; and the gastrula results from a pushing in of one part of this wall, in other words, from an invagination." Haeckel, however, thinks it possible to overcome this difficulty by assuming a "secondary falsification of the ontogeny." In his principal paper (17) he often repeats the assertion that delamination, in case it really occurs in the animal kingdom, is a cœnogenetic process, "which has secondarily arisen from the palingenetic process of invagination." As to the way in which such a falsification came about there is no explanation offered. This is the more to be regretted, as Haeckel himself felt the difficulty his theory encountered in this matter. Haeckel and his school, the Hertwig brothers in particular, long disputed the existence of delamination, but must surely admit it now, since a member of this very school, O. Hamann (26), has lately observed the process of delamination in the Hydroids (after it had been described by several previous investigators, among whom were Allman, F. E. Schulze, and myself). Hamann, however, will recognize no difficulty in this fact, and simply declares the delaminate planula to be a gastrula which has arisen by cœnogeny from an invaginate gastrula. "Delamination," states Hamann (l. c., p. 504), "is in all cases to be derived from invagination." "In view of the elsewhere universal presence of a gastrula," says he, farther on, "the doctrine, according to which a planula is but a transformed gastrula, will remain current." And yet again,

"We are justified in speaking of a form as a gastrula as soon as it can be made probable that the absence of both structures (blastosphere and gastric cavity) is of secondary origin. What we call a planula is, therefore, a gastrula formed by delamination." These assertions are made without adducing any grounds for their probability, and without making it in the least degree conceivable how invagination can be abbreviated into delamination, or what cœnogeny could effect for the origin of the latter. When one considers, moreover, that invagination is concentrated at one end of the embryo, and in the Medusæ is confined to a relatively small area of the blastoderm, while primary delamination or multipolar invagination takes place at the most various points of the embryo, it is evident that a reduction of the two latter methods to the former would meet with invincible difficulties. It is easy to understand how an invagination, originally confined to a small area, may gradually extend until, as is seen in various animals, it involves half the blastoderm. Further, one can see how a continuous layer of cells, destined to form the endoderm, may be changed into a cellular mass which is gradually enclosed by the growth of the ectoderm. But where the origin of the endoderm is an interrupted one,—that is, where the endoderm cells do not lie all together, but alternate with ectoderm cells (compare the development of Æginopsis), or where the endoderm appears as the central segments of the blastoderm cells,—it is impossible to refer the process to an abbreviated invagination. Multipolar immigration, to be sure, can be forcibly reduced to a number of invaginations, on which view each primitive gastric cavity would be represented by a single cell! It only needs to formulate such a hypothesis to demonstrate how utterly untenable it is; but, aside from this consideration, one would gain very little by accepting it, for primary delamination would still remain totally unexplained. It is between unipolar immigration and invagination that a relationship can fairly be assumed to exist, as has been maintained by Claus and others. It is impossible for me, however, without a previous discussion of other questions, to decide which form must be regarded as the more primitive.

Although its inability to explain the multipolar formation of endoderm is the weightiest objection to the Gastræa theory, it is by no means the only one. The theory was formulated at a time when the occurrence of intracellular digestion among the

lower Metazoa was not known, when in fact digestion in all cases (Metazoa) was believed to be enzymatic: naturally it is now unable to answer the questions suggested by our advanced physiological knowledge. The Gastræa theory would compel us to believe that a deep gap intervened between the one-layered blastosphere and the double-walled gastrula with its digestive cavity. This very awkward gap is, however, easily filled as soon as we abandon the Gastræa theory and seek to explain the origin of the endoderm in another manner. I need not dwell here upon the difficulties encountered by supposing all the known gastrula forms to be homologous. Such matters are not directly connected with our discussion of the primitive condition of the endoderm, and besides I shall have something to say on this point in another place.

The Planula theory of Ray Lankester (27) is based on the development of the Geryonidæ, and considers the method of forming the endoderm here employed, by constricting off the inner ends of the blastosphere cells, as the primitive type. Lankester endeavors to derive invagination from a primary delamination, such as occurs in Geryonia. But even were we satisfied with this derivation, there would still remain unexplained the cases where there is no actual delamination, but where the endoderm is formed of cells which migrate from various points of the surface into the interior of the embryo. The significance of this latter origin receives additional strength from unipolar immigration, the endoderm cells in both cases being blastoderm cells, which have arisen by longitudinal division from previous blastoderm cells. Moreover, the same objection must be raised to the Planula theory as to the Gastræa theory, namely, it rests on the assumption that digestion in the lower animals is enzymatic, and herein contradicts our actual physiological knowledge. Lankester believes that the formation of a cavity into which a digestive secretion was poured preceded the formation of the endoderm. In other words, the inner segments of the blastoderm cells functioned as digestive elements while the polyplast (blastula) was still one-layered. All these assumptions become quite inadmissible when once we learn that intracellular digestion persists in many of the lower Metazoa, and is even found in some Molluscs (Phylliroë).

While the Gastræa and Planula theories start with a blasto-

sphere composed of similar cells, Balfour (28, 29) adopts the amphiblastula as the transitional form between the Protozoa and Metazoa. I will therefore speak of his view as the Amphiblastula theory. Since it must be looked on as a modification of the Gastræa theory, it is open to the same objections as the latter. It is quite unable to explain the phenomena which occur when the endoderm does not arise as a single continuous structure, but as cells separated from one another by intervening ectoderm cells (the case of multipolar immigration especially). As regards the application of Balfour's theory to the Sponges, its untenability is shown by the fact that in many Sponges (especially Calcispongiæ and Halisarcinæ) the endoderm is a nutritive layer. This fact, already emphasized by early investigators and more than once by myself, has lately been confirmed by K. Heider (30) on *Oscarella lobularis*. The objection here raised, moreover, upsets the arguments which Balfour used to prove the isolated position of the Sponges among Metazoa.

Akin to the Amphiblastula theory is the Placula theory of Bütschli (22), not only because the latter author also believes in the separate descent of the Sponges, but because the placula in many respects may be considered as a flattened-out amphiblastula. Bütschli appreciates the weak points of other theories which deal with the genealogy of the germinal layers, and attempts in a purely diagrammatic way to construct the connection between invagination and delamination. He deduces both methods of forming the endoderm from the modification of a primary placula form. Abandoning the starting-point of other views,—the spherical colony of Flagellata,—our author adopts as his primitive form a Gonium-like one-layered plate, which for convenience I shall style proplacula. "It therefore seems fair to assume that the two layers first arose in a protozoan colony, the cells of which were arranged in one plane so as to form a one-layered plate. All the cells then divided parallel to the surface, and there thus arose a two-layered plate, the layers being probably as yet undifferentiated. To this stage of a two-layered plate we will give the name of placula." Such a placula, by assuming a sac-like form, became changed into a gastrula. In other cases the proplacula, in consequence of a secondarily retarded cell-division, gave rise to a delaminate blastosphere. As a result of these assumptions there would exist a radical difference in blasto-

spheres, which in some cases would represent swollen-up placulæ, in others proplaculæ that have become spherical. In the development of existing animals the placula, according to Bütschli, appears as the flattened blastosphere stage found in Cucullanus (Bütschli), Rhabdonema (Götte). Lumbricus, Chiton (Kowalevsky), Phoronis, and *Ascidia mentula*. Among adult animals it is represented by *Trichoplax adhærens* F. E. Sch. But Bütschli does not perceive that the flattened blastospheres of the Metazoa just mentioned agree with his placula in external form alone, and not in any essential or morphological respect. The fundamental difference between the two lies in the fact that the two layers of the former have not been acquired by cell-division parallel to the surface, which is the essence of the placula. In Phoronis, Ascidia, and, generally speaking, in the other animals cited above, the placula-like stage is attained by the flattening of a previously more or less spherical blastosphere, and not conversely as the theory requires. According to the theory the delamination of the Geryonidæ, accomplished by a transverse division of the blastoderm cells, is a process similar to the formation of a placula or amphiblastula, such as is supposed to occur in other animals. If this be true, we should find in the formation of this so-called placula a transverse division of the blastomeres. But this is not the case. The endoderm cells of the flattened blastospheres are not split off from the ectoderm cells immediately above them, but arise by the longitudinal division of parent cells. We are thus forced to the conclusion that a placula stage does not appear in the development of existing animals endowed with a regular segmentation. There is, however, a degree of similarity between the placula and a certain stage in the development of Ctenophores, where the endoderm has the form of a plate, and is covered by an interrupted layer of ectoderm. But this stage will scarcely be looked on by any one as embodying a primitive condition, and cannot, therefore, afford any basis for a morphological generalization.

If, going farther back in the development, we regard the eight-celled embryo formed by the transverse division of the first four blastomeres as a short-lived placula, we thereby gain nothing; for we must bear in mind that the eight-celled stage of the delaminating Geryonidæ is in all respects like the same stage of the invaginating Acraspeda, and must therefore be regarded as

homologous with it. If therefore the latter represents a placula, so must the former. But in this case the later delamination of the Geryonidæ, by means of transverse division of the blastosphere cells, could no longer be explained as the expression of a placula stage, because this stage would already have been passed.

Suppose, however, the assumption be correct that a placula stage occurs in the Metazoa with an invaginate gastrula. Then, since the placula theory can only explain the formation of endoderm, which takes place by means of a transverse division of the cells of a proplacula, all those cases would remain inexplicable where—the cell-division being exclusively longitudinal—the endoderm is formed by multipolar or local immigration.

According to Bütschli's theory, the blastosphere in animals that suffer delamination should be formed, as in Volvox, from a plate-like proplacula stage. He thinks, indeed (p. 423), the statements of Fol justify him in assuming the occurrence of such a stage in *Geryonia proboscidalis*. But the assumption is unwarranted, for the sixteen-celled embryo of the Geryonidæ is in itself a typical blastula, produced from an eight-celled stage precisely as in Medusæ which form their endoderm by a totally different method. The eight-celled embryo has likewise been produced by just such an equatorial division as occurs in other Medusæ and in most Metazoa with an equal segmentation. Among the latter *Sycandra raphanus*, according to F. E. Schulze's account, most nearly resembles Volvox as regards the stages preceding the blastosphere. In this sponge is found a plate-like eight-celled stage, which, however, can be of no value to the placula theory, since later on in the development there occurs an invaginate gastrula.

The morphology of the interesting *Trichoplax adhærens* F. E. Sch. (32) and its relations to the placula cannot be seriously discussed at the present time, since it is impossible to decide, with even a show of truth, what significance must be attached to the several layers of this animal. From the histological difference between the epithelial coverings of the two surfaces of the body, we cannot infer that different germinal layers were involved in the formation of these coverings, any more than in the Sponges where the same layer, the endoderm, appears in the chambers as flagellate epithelium and in the central cavity as flat epithelium

(for example, in *Oscarula lobularis*, according to K. Heider). The difficulties presented by Trichoplax are heightened not only by our ignorance of the development, but by our lack of any facts from which to determine the physiological functions of the several layers of the body. Thanks to the kindness of Professors F. E. Schulze and Claus, I was enabled in 1883 to study Trichoplax both at Graz and Vienna, and to fully confirm the histological discoveries of the former investigator. My experiments on the manner in which the animal fed gave purely negative results, for it would take no solid food at all, thereby lending countenance to the view that Trichoplax depends on fluid nourishment alone.

Bütschli thinks the Placula theory is of more value from a physiological point of view than the other theories criticised by him. "Finally, it seems to me very important," says Bütschli (l. c., p. 416), "that the changes undergone by the assumed forms are easily comprehended, that they take place gradually, not by jumps, and are actually advantageous." "Especially in this latter respect," adds Bütschli, "is the new view about to be developed superior to its predecessors." When, however, it comes to explaining physiologically the origin of the placula, no satisfactory reasons are given why it should arise. "I regret that I am unable to adduce," Bütschli confesses himself (p. 419), "any plausible advantages to be gained by the plate on its becoming two-layered."

(To be concluded.)

THE ORIGIN OF A SMALL RACE OF TURKEYS.

BY JOHN DEAN CATON, LL.D.

THE effect upon the progeny of animals of inbreeding, or where the parents are nearly related, is a subject well worthy the attention of naturalists, though I am not aware that it has been the subject of careful study, especially among the lower forms of animal life.

With man it has undoubtedly received much attention, but even here it has been rather of a desultory character than that careful and systematic attention which its practical importance

would seem to justify. It has received attention undoubtedly from breeders of domesticated animals, but even here, so far as I am aware, are wanting long-continued experiments and careful observation. The most that can be said is that a general impression prevails among breeders that the offspring of very near relatives is seriously impaired in constitution and form. Yet instances have been cited where for one or two generations, at least, an improvement has been observed in both of these respects, and I do not remember to have seen any statement of well-authenticated observations justifying the general impression which undoubtedly prevails among the breeders of domestic animals. With the human race the fact of such deterioration resulting from the near relationship of the parents may be considered as well established, and it may be possible from this recognized fact the conclusion has been drawn that the same causes must produce the same effects among the lower orders of animals. This is a subject in which the professional breeder no less than the professional scientist should feel a deep interest, and it is to be hoped that some of these will institute careful and long-continued experiments which may throw valuable light on this subject.

A few isolated cases would be far from conclusive, yet the result of each one would have its value. These experiments should not be confined to one species alone, but should cover the entire range of domesticated animals.

In some species an actual improvement might be the result, while in others the most disastrous consequences might be observed.

With the hope of acquiring some light on this subject, some years since I disposed of all of my elk (Wapiti deer) excepting one pair, which were three years old, and when a large herd shall have been raised from this single pair we may be able to form some opinion of the effect of interbreeding upon this species of deer. The second fawn produced from this pair was a female, and she died yeaning when two years old, and since then there has not been sufficient time for the production of the inbred progeny; but even this experiment may not be entirely satisfactory, for the Wapiti deer I have found to be the most hardy and reproductive in domestication of any of the deer family.

Ten years ago I sent a number of wild turkeys from my grounds in Ottawa to Santa Cruz Island, situate in the Pacific

Ocean about twenty miles off this coast. During my stay here this winter I have formed the acquaintance of Mr. J. P. Joyaux, who at that time had charge of the island, which was used principally as a sheepwalk. It is about thirty miles long, and five to ten miles wide. There were no enemies upon the island with which the turkeys had to contend except a small gray fox, which was quite abundant. Six turkeys were received by Mr. Joyaux, two cocks and four hens. One of the cocks died soon after their arrival. They were received in the winter. The next season the four hens raised to maturity sixty-one birds, which when grown up were as large as their parents. The year following the produce was one hundred and twenty, of about the same size. I may here remark that the wild turkeys in my grounds at Ottawa, which have been hatched from eggs taken from the nest of the wild hen in the woods, have never bred till they were two years old, but some of the first generation raised in the grounds have bred when a year old, and generally the second or third generation have reproduced at a year old. Probably, therefore, not all of the hens of the first year's brood bred the next year, and this may account for the smaller relative product the second year than the first, and it is possible, and even probable, also, that Mr. Joyaux was unable to enumerate all of the second year's produce. After that they had wandered away and reverted to the wild state, so that it was impossible to form any opinion of the increase, only that they have become very abundant, and are met with in the forests far away from the ranch where the first were turned loose, and if they are not as wild as the wild turkey is observed to be in his original haunts, it may be attributed to the fact that they are not hunted with dog and gun.

In a very few years these birds bred upon the island were observed to have diminished very much in size, so that now it would be impossible to find a cock which would weigh over six pounds, which is less than one-third the size of their original ancestor or of the first and second generation bred there.

Mr. Joyaux attributes this remarkable deterioration in size to inbreeding. He says their food is abundant, consisting of small acorns, a great variety of berries, an abundance of insects, and plenty of grass. While they do not get our domesticated grains, they find plenty of seeds of grasses and herbaceous plants in their season, and plenty of water everywhere.

This is undoubtedly a case of pretty close inbreeding, the entire stock having descended from one male and four female ancestors. While I do not consider it conclusively established by any means that this deterioration in size should be attributed solely to inbreeding, it is not unlikely that this cause may have had its influence; nor am I prepared to assign any other satisfactory cause for this remarkable result. Although the native wild turkey was never found on the west side of the Colorado, while it was abundant in Arizona, not far east of that river, there would seem to be nothing in the condition of this country especially detrimental to their well-being here. The wild turkey which I have introduced in various places on the mainland north of San Francisco are reported to have done well. They are said to be prolific and healthy and to attain their normal size; and the domestic turkey, which is found all over the State, is said to do fairly well, although upon the table they are not as much admired as those raised in the Eastern States, nor are they in general as large or as fat.

No epidemic has been observed among the turkeys on Santa Cruz Island; but, on the contrary, they seem to have been always healthy and vigorous. Their habit of flight as represented to me is about the same as that observed of the Eastern wild birds in their native haunts. The flesh of these small birds is said to be good.

I have been thus particular in my account of the introduction of the wild turkey upon the island of Santa Cruz because I think it entitled to some weight at least in the investigation of the question which I have suggested.

It may be impossible to obtain facts which can throw much light upon the effects of inbreeding among wild animals in their unrestrained condition, especially those of monogamic or promiscuous habits, which is the case with most wild animals. Among quadrupeds where two are usually produced at a birth, so far as observed, the twins are usually male and female, and most probably they continue together in close intimacy till they attain a reproductive age; and here we might reasonably expect that inbreeding would very often occur, and yet there may be conditions which would disappoint this expectation, such as, for instance, the older males in the forest driving off the younger. In the case of quadrupeds where several are produced at a birth,

we might expect that inbreeding might still more frequently occur, but, after all, it is only where animals are subjected to the control of man that it is possible to make observations which can give us any satisfactory results upon this subject; so that, as before suggested, our only hope for reliable information on this subject must rest with the breeders of domestic animals. Should they take interest enough in it to make careful and numerous and long-continued experiments with the various species of animals under their control, something like certainty might be obtained where we have now nothing better than conjecture.

SANTA BARBARA, CAL., February 24, 1887.

SONNETS.

CACTUS.

(Prickly Pear.)

I KNOW an isle, clasped in the Sea's strong arms,
Sport of his rage and sharer of his dreams;
A barren spot to alien eyes it seems,
But for its own it wears unfading charms.
From Spring's first kiss to Autumn's last caress,
Gayly its moorlands bloom, from strand to strand;
And many a favored nook, by west winds fanned,
Holds flowers unmatched for tint and loveliness.
But most I mind me of a lonesome shore,
For countless gulls a harbor and freehold,
Where, like some shipwreck'd buccaneer of old,—
Cast on the sands, condemned to rove no more,—
In spiny armature, secure and bold,
The Cactus lies at length and guards its gold.

NANTUCKET, July.

NOTE.—The island of Nantucket is the northern limit of *Opuntia vulgaris*.

PARNASSIA.

(Grass of Parnassus.)

Oh, stately, calm, and pure, as best beseems
One born in that far land of sun and song,
Beloved of gods and men, whose vales along

Strayed once the sacred Nine, and by whose streams
The great Pan piped;—remote and strange it seems
To find thee here, 'mid grasses rank and long,
Where, by the hidden brook, serene and strong
As Autumn's smile, our clear-eyed Gentian gleams.
Perchance it was her blue and fringéd eyes
That lured thee from thy storied home to range,
And tempted thee to give, in glad exchange
For such a heaven, thy classic Grecian skies:
It well may be, since beauty knows no clime,
And love, immortal, conquers space and time.

October.

WITCH-HAZEL.

What time the dainty darlings of the Spring,
Summer's ripe beauties, Autumn's brilliant train,
In swift procession trooped o'er hill and plain,
Thro' vale and grove, while every bird did sing
His fitting song;—we took no note of thee,
O arch enchantress of stream-haunted woods,
Waving aloft thy flowerless magic rods,
And whispering to the winds their mystery!
But when the merry carnival is o'er,
The banners furled, the gay robes laid away,
Thou shinest forth in marvellous array,
Charming our thoughts from all that passed before.
Is it to witch old Winter with thy wiles,
This burst of golden hair and sun-bright smiles?

Emily Shaw Forman.

November.

EDITORS' TABLE.

EDITORS: E. D. COPE AND J. S. KINGSLEY.

THE judicial attitude in all things is, in the present stage of human development, a far from common accomplishment. Philosophy, however, requires it, and scientific men should be, if possible, philosophers. But it is precisely this class whose philosophy is most frequently put to the test by their fellow-men. To a majority of the human race the intellectual life is a shadow not worth pursuing, and those who pursue it are correspondingly disesteemed by them. The defect of the intellectual type of mentality in a community is a stage of development which is the parent of better things or worse things. From it may arise a society of philosophers, or of religious devotees, or of Heliogabali and Vitellii. That the type of face that characterized the last of the imperial family of Rome is appearing in our streets is quite evident, and it will require the exertions of the devotional and intellectual classes to prevent it from becoming still more common. That Brother Jonathan should come to resemble a Nero would be an unexpected metamorphosis; yet signs are not wanting that such a degenerative process is not impossible. The unintellectual materialism which characterizes the majority of the wealthy classes of Americans will be watched with serious curiosity. Some of the wealthy will direct their stored energy to the improvement of their race; others will expend it in degenerative processes. Which type will prevail?

The excellent services of the religious world in directing human activity away from destructive channels should be perceived and sustained by the scientific community. Nevertheless, it cannot but be lamented that the work of the churches is often more profitably directed to instructing the people as to what they should *not* do, and not sufficiently clearly as to what they *should* do. It is in the latter direction that weakness is often apparent. Nevertheless, the influence of the churches in this direction also is of incalculable benefit.

It rests with the scientific world to bring out the facts of the universe, or, in other words, the truth. And knowledge of the truth is the only safe guide as to what men shall do and what they shall not do. But this service does not furnish energy.

It offers only light. Light may be refulgent, and men may "love darkness rather than light." So the office of supplying to men the energy to act will never be an unimportant one. But let that energy be applied in the direction of light, and not in any other way. It is the disposition to set ancient dogma over modern light that furnishes the *raison d'être* of the odium antitheologicum. The enlightened mind revolts against this tyranny over intelligence, and excuses for its authors are not always at hand. Let science, however, avoid bigotry on her side, and she will gain by the contrast. She can afford to be judicial, remembering that the earlier stages of human as of lower evolution are all about us, and that they furnish plastic material ready to her hand.

RECENT LITERATURE.

Strasburger and Hillhouse's Practical Botany.[1]—Some time ago we noticed briefly the original German edition of this book, which appeared under the name "Das Kleine Botanische Practicum." We now repeat our conviction of its great value to the beginner, and trust that it will be widely used in this country. The additions made by the author and English editor have added greatly to its usefulness.

Throughout the work much attention is given to the instruments and apparatus used in investigation, the work differing in this respect from any others of its kind. The authors do not think it trifling to give particular directions as to the cleaning of cover-glasses, the placing of a drop of water upon the slide, etc. A dozen pages are devoted to instruments, reagents, etc., and then the student "learns to do by doing." Studies of starch, aleurone, protoplasm, chromatophores, tissues, bundles, etc., follow one another in succession, the student being thus led over the field of general histology, after which he takes up in order the study of selected examples of the lower plants, the Bacteria, Algæ, Fungi, Lichens, Mosses, Liverworts, Vascular Cryptogams, finally reaching the Gymnosperms and Angiosperms.

A valuable feature of this edition consists of the lists of "ma-

[1] "Handbook of Practical Botany," for the botanical laboratory and private student, by E. Strasburger, Professor of Botany in the University of Bonn, author of "Zellbildung und Zelltheilung," etc. Edited from the German by W. Hillhouse, M.A., F.L.S., Professor of Botany and Vegetable Physiology Mason Science College, Birmingham, formerly scholar of Trinity College, and Lecturer in the University of Cambridge. Revised by the author, and with many notes by author and editor. With one hundred and sixteen original and eighteen additional illustrations. London: Swan, Sonneschein, Lowrey & Co., Paternoster Square, 1887.

terial wanted" placed at the head of each chapter. In the appendix are to be found a list of plants and parts of plants used for study and a list of the reagents necessary, with directions for their preparation and use.

We cannot refrain from quoting a few sentences here and there from the book. In speaking of microscopes, the translator remarks, "As the English student will probably purchase a microscope of home manufacture, it is desirable to state here that the larger and typically English stands are not to be recommended for student use. Their length of body makes it exceedingly difficult to use them upright without a special table; and the upright position is, all round, the more convenient for student work. Nor are mechanical appliances for moving the object-slide about on the stage of utility commensurate with their cost and the want of independence which they induce. Most of the English makers manufacture microscopes with tubes of about the 'Continental' length, but of better workmanship than the ordinary 'student' stands, and suited for the addition of accessory illuminating and other appliances." In another place, when speaking of the "rack and pinion" adjustment, the translator says, "It is, however, of doubtful advantage to the learner."

The objectives recommended are three-quarter and one-sixth inch. Razors, forceps, dissecting scissors ("for which fine embroidery scissors will serve"), needle-holders and needles, scalpels, small brushes, "a small vise, such as used by watchmakers," pipettes, glass tubes and rods, watch-glasses and glass disks for covering them, bell-jars and zinc frames for moist chambers, bell-jars for the microscopes, elder pith, "a tumbler of clean spring water," and a saucer for dirty slides, are enumerated as the necessary apparatus upon the table.

It remains to be said that the English publishers have done their work well; the print, paper, and binding are just what they should be for a laboratory manual.—*Charles E. Bessey.*

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GENERAL NOTES.

GEOGRAPHY AND TRAVELS.[1]

America. THE MUIR GLACIER.—The Muir Glacier, which presents a front of one mile to an inlet at the head of Glacier Bay, Alaska (58° 50′ N. 136° 40′ W.), has been investigated by Mr. G. F. Wright. Near the mouth of the bay is a cluster of low islands, evidently formed of glacial débris, and forested. The islands and shores in the upper part of the bay are devoid of forest. The mountains east and west of Muir Inlet are respectively two thousand nine hundred and three thousand one hundred and fifty feet high. Between these mountains the glacier is ten thousand six hundred and sixty-four feet wide. The angle of ice projects into water five hundred and sixteen feet deep, and is itself two hundred and fifty feet high. The surface of the ice rises to the east and north about one hundred feet to the mile. The main body of the glacier occupies a vast amphitheatre, with diameters ranging from thirty to forty miles. Nine main streams unite to form the grand trunk, and seventeen sub branches can be seen. Rocky eminences rising above the surface are smoothed and scored and have glacial débris upon them, showing that, like the islands in the bay, they have been recently covered by ice. On the side from which the ice approached these islands it is several hundred feet higher than on the lee side. The ice in the eastern half of the amphitheatre is moving much more slowly than that in the western half. Much water runs below, and here and there there are superficial streams which eventually plunge downward through the ice. The front is perpetually breaking off, and Mr. Wright calculates that in August one hundred and forty million cubic feet enter the water daily, since the whole mile of width and seven hundred feet of depth move on at a

[1] Edited by W. N. LOCKINGTON, Philadelphia.

rate of forty feet per day. Evidences of the recession and diminution of this glacier are numerous.

American Notes.—Dr. Ten Kate has completed his explorations in Surinam, during which he visited the valley and grotto of the Guacharo, and has returned to Holland.

Mount St. Elias is, according to Mr. Seton Karr, not less than three miles east of the 141st meridian, and is thus in Canadian territory. The area of the Agassiz and Guyot Glaciers is estimated at not less than eighteen hundred square miles, but the Tyndall Glacier, issuing from the southwest face of the mountain, is the principal. Mr. Karr ascended one thousand feet higher than Lieutenant Schwatka. He thinks that the Jones River is produced by the melting of the glaciers, as he saw no break in the chain.

Africa. The German African Association.—Count Pfeil has made two important journeys for the German East African Association. On the first, after traversing the district of Makata, he entered that of Khutu, which has been acquired by the Association. The second journey was principally occupied by the exploration of the Ulanga River, which he ascended for one hundred and fifty miles to 35° 5′ E. long. and 9° 5′ S. lat. Below the Sugali Falls the river is known as the Rufiji. From Ngahoma towards its source in the mountains, northeast of Lake Nyassa, the direction of the river is first west and then southwest. The depth of its lower course varies from ten to more than twenty feet.

Dr. Lenz's Journey.—Dr. Lenz reports great changes upon the Congo in the upper cataract region. The natives have to a great extent retreated from the river, and their place is occupied by trading settlements of Africans and Zanzibaris. Kibonge, two days above the last cataract, has some hundreds of homesteads and a few thousand inhabitants. Riba-Riba, named after its founder, a Mohammedan negro from Nyangwe, is also a large settlement. There are now enormous rice-fields in this region. Nyangwe is now less important as a trading-place than Kasonge, Tippoo Tip's headquarters, a few days to the southeast. The whole of the region is in the hands of the Arab traders and their dependents. Said Mohammed Kasuenda is Tippoo Tip's friendly rival.

Dr. Fischer's Last Journey.—The late Dr. G. A. Fischer's journey in Eastern Equatorial Africa, though it failed in its main object, has added much valuable information respecting the east coast of Lake Victoria Nyanza. On his way out from Pangani, through Uwerewere, he ascertained that the Muara (Stanley's Liwumba) does not join the Simiu, but loses itself in the plains, or, in the wet season, in a lake. Rounding Speke Gulf, the party entered the sparsely-wooded country of Shashi, with mountains

five thousand feet high and an agricultural people. Kawirondo was crossed, and progress north was stopped by want of food at Ulala, the capital of Njoro. Returning, Thomson's route was followed by Lake Bavingo to Lake Naivasha. Here the party struck across the highlands of Kinangop, crossed the Aberdane range at a height of eight thousand nine hundred feet, marched through the thickly populated and richly cultivated district of Kikuyu, and, turning southwest, passed through the district of Ulu, along the east of the Ulu range, across the head-waters of the Ssabaki, and *via* Kissigau to Wanga, on the coast.

AFRICAN NOTES.—Dr. Junker reached Zanzibar December 11. On a late journey he followed the Welle-Makua to 22° E., only one hundred and fifty miles from the point upon the Mobangi reached by Mr. Grenfell.

Mr. J. A. Wray has reached the water-edge of the picturesque crater lake Chala, on Mount Kilimanjaro. There is but one spot, on the west side, where this small lake, which is surrounded by wooded banks one thousand feet high, can be reached. The water is clear, cool, and sweet, there is no mark of higher water, and no apparent inlet or outlet.

A monthly mail has been established between Zanzibar and the stations of the London Missionary Society on Lake Tanganyika.

Dr. Rousjie believes that he has been able to identify all the peaks of Central Tunis mentioned by Ptolemy and to confirm his hydrography.

Mr. J. T. Last has travelled from Blantyre to the Namuli Hills, traversing a district before unknown to Europeans. Lake Limbi is a long, narrow pool, forming the head-waters of the Sombani River.

It is said that Tippoo Tip has given in his adhesion to the Congo Free State and regrets the taking of the Falls Station, which occurred during his absence. Mr. Stanley was accompanied from Zanzibar to the Congo by Tippoo Tip, and expects the restoration of the falls through time. *Nature* states that upon his arrival at Stanley Falls with the first contingent of about two hundred and fifty of his men, Stanley will at once proceed to Emin Bey, taking with him probably a reinforcement from Tippoo Tip.

Asia. THE DRAGON LAKE.—According to Buddhist cosmogony, the four rivers of Paradise issue from the Dragon Lake of Central Asia. Hwang-Tsang, a Chinese traveller of the seventh century, visited this lake, and it appears that it is identical with Lake Rang-Kul, recently visited by Mr. Ney Elias in his journey across the Pamir from Yengi-hissar to Shignan. This is, at least, the opinion of Sir H. Rawlinson. The banks of the lake are encrusted with salts, yet the waters are sweet. A tribu-

tary of the Murghab seems to communicate with the lake by an underground channel, but the Kashgar River does not, as was stated by Hwang-Tsang, communicate with the lake. It is said to be presided over by a dragon, who is supposed to guard immense treasures and to reside in a cave near the summit of Cheragh-Tash, or "lamp-rock," a rock about one hundred feet high near the water's edge. A light, probably phosphorescent, burns in this cave, and is said to be the sparkle of the diamond in the dragon's forehead.

JAPAN.—The very interesting account of the physical geography of Japan, with remarks upon its people, contributed by Dr. E. Naumann, who has had in charge the geological survey of Japan, is itself too condensed to be capable of satisfactory condensation. Dr. Naumann states that the Japanese islands are the most elevated portions of an enormous chain of mountains, the height of which must be measured by adding the depth of the Tuscavera basin to the altitude of Fujinoyama (12,425 feet). These mountains are a vast earth-wave, the advanced frontier of Asia, igneous but not volcanic, since volcanoes play a very humble part, and fossils of the remotest periods are met with. The "Radiolarian slate" is Palæozoic. The angle of descent of the ocean-bed is about 3°. The Japanese chain consists of a long series of folds, running, as a rule, in the same direction as the chain, but towards the northeastward curving hook-like towards the Japan Sea. West of Tokio is a great transversal cleft or fissure in which several volcanoes, including Fujinoyama, have sprung up. The folds seem to have advanced from the Sea of Japan towards the ocean, but the great fissure resulted from their encounter with another chain stretching from Tokio Bay to the Bonin Islands. Dr. Naumann writes as one enchanted by the beauty of Japanese scenery, and has much admiration for the people, though his estimate of the Japanese house is more matter-of-fact than that of Professor Morse. Farmhouses have a hole for the smoke of the fire to escape, as was the case in England in Saxon times and later, and even rich Japanese feel at home in small and perishable structures.

AFGHANISTAN.—Afghanistan is still so far an unknown country that Captains Maitland and Talbot found a well-defined elevated tract filling up the whole space between the Hindu-Kush and the high mountains about the sources of the Hari-rud and Murghab. This range runs east and west at a distance of from five to twelve miles from the towns of Tashkurgan, Mazar-i-sharif (now the capital of Afghan Turkestan), and Balkh. It is hardly indicated on any map, and is not mentioned by previous travellers. The Hazanahs are a simple, good-natured people.

ASIATIC NOTES.—M. Tchersky has published at St. Petersburg a geological map of the borders of Lake Baikal.

The Russian Geographical Society has appointed a committee

to make more thorough investigations into the subject of the desiccation of the Siberian lakes.

The river Kara-ssu, near Lake Balkash, marked on existing maps, does not exist, and the streams of the At-Lessken range have long been dry. The water of the river Ili is being diverted to the eastern arms of the delta, while the western channels have become mere pools of standing water. The water in the main stream has not overflowed for three years, while the Kurli arm of the delta is becoming filled.

A new glacier called the Mushkelof, discovered in the Khan-Tengri group, exceeds in size the well-known Ssmenof Glacier.

Dr. Bunge and Baron von Toll have succeeded in their attempt to reach the New Siberian Islands. The former explored Ljachow, the latter Kotelny. Earlier the two explored five other islands. They returned to the mainland in October last.

Major Macgregor has contributed to the *Proc. Zool. Soc.* an account of Colonel Woodthorpe's expedition to the Irawadi. The ruling race in the district is that of the Buddistic Kamptis, who are Shans, and do not exceed twelve thousand in number. Their dress resembles that of the Scotch Highlands. The other races are the Singphos or Kakhyens, who are Thibeto-Burman by race but are spirit-worshippers, the Mishmis, a small, active, dirty race of Mongolian type, and the Nagas, who are miserably poor and almost without clothing.

Australia and Oceanica. THE NEW BRITAIN GROUP.—In the January issue of the *Proc. Roy. Geog. Soc.* Mr. H. H. Romelly gives an account of New Britain and New Ireland, or, as the Germans now style them, New Mecklenburg and New Pommern, as they were in 1881–1883, at which date the white population consisted chiefly of roughs and runaways. The two most conspicuous objects on approaching New Britain are the conical mountain named Mount Beautemps Beaupre and an extinct volcano named The Mother. The latter shelters the harbor of Blanche Bay, which is surrounded by volcanoes, some still active. Vegetation is most luxuriant, and the forest-trees are covered with ferns, orchids, and lycopods. The natives are good agriculturists, making the most possible of the almost inaccessible spot to which mutual hostility compels them to resort. Our authority places the native population of New Britain at one hundred thousand, that of New Ireland at half that number. The former island has numerous small rivers, while the latter seems to have none worthy of the name. Good harbors have recently been discovered at the northwest end of New Ireland, and German traders are now stationed there. New Hanover, a large island northwest of New Ireland, has many rivers, fertile valleys, and wide-spreading plains sloping up to the high interior, but the natives are uncompromisingly hostile.

In New Britain betrothals take place at a very early age, but a high price is fixed on the girl, so that the man is often middle-aged before he can marry her. He may get impatient and elope, but in that case dare not return to his tribe. But elopement usually takes place when the price is nearly paid. The couple build a house in the bush; both families assemble, vow vengeance, paint as if for war, and sally forth and burn the house, from which the culprits are absent; the couple come back to the village in the morning, and the rest of the money is eventually paid. The curious point is that if after all the waiting the woman will not live with the man he cannot recover the property he has given to her parents.

The writer describes in detail the ceremony of the duk-duk, who is supposed to be a spirit who appears at the break of the day of a new moon. Men covered with a tunic and a very high hat personate the duk-duk and irritate the young men with blows of cane and club. Cannibalism—at least in the form of eating enemies killed in battle—still exists in these islands.

The Rev. George Brown, a Wesleyan missionary long resident in Duke of York Island, between New Britain and New Ireland, confirmed the charge of cannibalism, stating that when on one occasion he adventurously crossed New Ireland he saw at one house thirty-five human jaw-bones, some just picked, hanging on a rafter. The west coast of New Ireland was very well watered, and had large rivers. The standard of value among the people is six feet of strung shells, and the natives have words signifying "buy," "sell," "borrow," "lend," and "redeeming" a pledge, lend money at ten per cent., and have a word equivalent to "selling at a sacrifice."

New Guinea.—The Rev. I. Chalmers's account of his journeys in New Guinea (*Proc. Geog. Soc.*, February, 1887) contains, like all accounts of journeys in this region, far more ethnographical than geographical information. In 1878 Mr. Chalmers and his wife visited the whole coast from China Strait to Hall Sound; after this he went inland from Catamaran Bay to Discovery Bay, and he made several inland trips from Port Moresby. He also voyaged in a native "lakatoi," made of three dugouts lashed together, from Port Moresby westward to the Annie River, visiting the cannibal district of Namau, and becoming so extremely friendly with the cannibals that the wonder was that they did not eat him for sheer love of him. Mr. Chalmers jests about the "skullery,"—an open space near the dubu, or temple, provided with pins to hang skulls on. The skulls were all carved and gayly colored. The dubu was nearly two hundred feet long and about eighty feet high to the peak in front, where there was a large veranda, but diminished to nine feet at the back. The aisle, hung with curtains of the frond of the young sago-palm, had a floor polished with blood and the tread of feet.

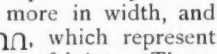
Inside there were six wicker gods with enormous frog-mouths and dugong-like bodies.

The Empress Augusta River, in German New Guinea, has been navigated for two hundred and twenty-four miles by Admiral von Schleinitz in the "Ottilie." The steam-launch proceeded one hundred and twelve miles farther, and returned from want of fuel. This was in the dry season.

GEOLOGY AND PALÆONTOLOGY.

Hummocks and Boulders of Decomposition in Southeastern Missouri.—Among the crystalline hills of Southeastern Missouri boulders of decomposition are frequently seen. In fact, it was owing to a small eminence—two hundred feet above the ancient broad Cambrian valley—being covered with detached boulders of iron ores that the name Iron Mountain derives its origin. From its surface it is said that seventeen million tons of iron boulders have been taken, these having been left behind by the removal, during long ages, of the intervening decomposed feldspathic rocks. Throughout the region the surfaces of the crystalline rocks are covered with their decayed remains to a depth from a few feet to fifty or seventy-five feet.

The rocks to which attention is here called are those of a knob, about five miles from Iron Mountain, rising out of a broad valley, where the quarries of Graniteville are situated, at an elevation above the sea of about twelve hundred feet, south of latitude 38° N.

The surface of the red granulite is commonly covered by its own material decomposed *in situ* to a depth of only a few feet. The decay is not always gradual from the surface inward, but frequently *per saltum*, leaving hard surfaces immediately below the more or less decomposed materials. But over an area of several acres these rocks are not covered with earthy matter. Here may be seen perfectly rounded or ellipsoid hummocks from twenty feet or less in width to forty or even one hundred feet. Some of the ridges are unbroken for a length of several hundred feet, while others are made up of a chain of hummocks, whose general trend as well as slope is southwest,—the same direction as that of the prevailing, but not numerous, joints shown in the adjacent quarries. Some of the parallel ridges or chains have flat, rounded surfaces, thus,  , whilst others are like inverted U's, separated by narrow furrows from one foot to five feet or more in width, and from ten to twenty feet deep, thus, , which represent deep weathering and removal along the lines of joints. These hummocks have perfectly the form of typical *roches moutonnées*—less only the frequent, although generally superficial, scratches—of modern glacier regions. In many places, upon what we may call the *roches moutonnées* of Graniteville, there are boulders,

more or less rounded, still fitting into their original places, although the decayed connecting rocky matter has long since been removed. Most of the boulders have spheroidal or ellipsoidal forms, and resemble as much northern erratics, or perched blocks, as any seen within the drift zone of America or modern glacier regions of Europe. One of these boulders is about thirty feet long, fifteen feet broad, and twenty feet high, perched on top of a rounded hummock, and resting on only a few small points.

When one compares the forms of these rocks south of the line of northern drift, and of others similar in the more southern Appalachians, and reads of the same in warm countries, as Ceylon and Brazil on the one hand, and, on the other, with those of the Swiss valleys and the greater and more wide-spread rounded surfaces of Norway, still in contact with living glaciers, —where he may see how unimportant a factor is the land-ice in gnawing away the old crystalline rocks,—one is forced to look upon the structure of both as more or less of common origin,—atmospheric erosion, perhaps aided by currents,—although the latter region has been swept off by a brush of ice which has left scratches behind.—*J. W. Spencer, University of Missouri, Columbia, Mo.*

The Dinosaurian Genus Cœlurus.—This genus was described by Marsh, in 1871,[1] from material obtained in the Jurassic deposit of Wyoming Territory. Characteristic bones not distinguishable as to genus from those described by Marsh are in my collection from New Mexico, probably from beds of Triassic age. They consist of nearly all parts of the skeleton, excepting jaws and teeth, and but little of the skull is determinable. The material is much more complete than that described by Marsh.

The remains show that the genus Cœlurus is a Dinosaurian, and I cannot agree with Professor Marsh's view "that Cœlurus cannot be placed in any known order."[2] The ilium has the general character of that of the carnivorous suborder (Goniopoda), and the other parts of the skeleton confirm this reference. Such is the possession of compressed, strongly-curved claws, which were capable of very extensive flexion and extension. Cœlurus is in fact allied to Megadactylus (Hitchcock) from the Trias of Massachusetts, differing principally, so far as determinable, in the form of the condyles of the femur. They are simple in Cœlurus, but in Megadactylus the external condyle has the double character seen in Megalosaurus.[3]

The vertebræ are all of slender proportions, especially those of the neck and tail. These, with most of the bones of the

[1] Amer. Journal Sci. Arts, p. 339, Plate X. [2] L. c., p. 340.
[3] See Cope, Trans. Amer. Philosoph. Soc., xiv., 1870, Plate XIII.

limbs, are hollow, having large central cavities surrounded by thin walls, as in Megadactylus. There are four sacral vertebræ. The phalanges are elongate. The anterior caudal vertebræ only have chevron bones. These have escaped Professor Marsh, who says they are wanting; but he does not appear to have possessed the most anterior of the series. In neither species is there a distinct third trochanter of the femur, but there is, not far below the great trochanter on the anterior face, a low, longitudinal, ridge-like angle. The femoral condyles have but little anteroposterior extent, which implies but little flexure of the knee. The humerus is a good deal smaller than the femur, but the disproportion is not so great as in Lælaps.

The form seems to have been that of a terrestrial reptile which walked readily on the hind legs, and was probably a great leaper. The extremely long neck is a striking peculiarity, giving proportions to the body about like those of the swan. The habits were probably predaceous and carnivorous.

Two species are indicated by my collections, as follows:

Cœlurus longicollis. Cervical vertebræ one-third longer than those of *C. fragilis* Marsh; the sides of the centrum not sulcate; the anterior articular face of an anterior centrum not convex. The faces are oblique, showing that the head was carried above the level of the body. The caudal vertebræ were all quite slender, indicating the length of the tail.

Length of body of cervical vertebra		.063
Diameters of posterior cup	vertical	.016
	transverse	.019
Length of centrum of dorsal vertebra		.042
Diameters of posterior face	vertical	.020
	transverse	.021
Length of caudal centrum		.051
Diameters of posterior face	vertical	.023
	transverse	.021
Length of femur		.215
Diameters of condyles	antero-posterior	.024
	transverse	.030

This reptile was about the size of a greyhound.

Cœlurus bauri.[1] In this species the sides of the cervical centra are deeply and widely grooved on the posterior half, and the superior face of the neural arch is strongly grooved on each side on the anterior half. The size is much inferior to that of the *C. longicollis.* The femur is not so strongly grooved at the third trochanteric ridge.

Diameters of cervical centrum behind	vertical	.0115
	transverse	.013
Length of sacrum		.073
Diameters of anterior sacral centrum in front	vertical	.014
	transverse	.015
Transverse diameter of femoral condyles		.022

[1] Dedicated to Dr. George Baur, the distinguished comparative anatomist of New Haven.

The horizon from which these species were obtained is probably upper Trias. It becomes, therefore, important to re-examine the locality from which Professor Marsh obtained the *Cœlurus fragilis* to determine whether its deposit is really of Jurassic age, as stated by Marsh. It is, however, not fixed beyond doubt that the New Mexican locality is Triassic.—*E. D. Cope.*

Geological News. GENERAL.—M. Nouvy, in his "Geology of Jersey," assumes that the island had an original granitic crust on which the gneisses were deposited in an intensely heated ocean. The sedimentary rocks are chlorite-schist, feldspathic schist (which is most common), metamorphic schist, and conglomerate. There is much eruptive rock, varying from granitic to diorite. The author states that the age of the true granites now found cannot be proved, but that the other eruptive rocks are certainly later than the schists. No sedimentary rock exists between these Cambrian strata and the conglomerate, which he attributes to the Permian age. After a careful sifting of the evidence, he concludes that subsidence has occurred only since the Roman occupation, and that Jersey was probably still joined to Normandy in the sixth century.

DEVONIAN.—M. Ch. Deperet has studied the Devonian of the eastern chain of the Pyrenees. This formation forms a narrow band running 15° north of east, parallel to the general direction of the chain. The belt can be traced across the basins of the Aude and the Tet, from the elevated valley of the Aniège on the west to the plain of Reussillon on the east, and has a length of sixty kilometres, with a width of five kilometres at the mountain-mass of Villefranche. The western part of this Devonian crest is nearly uninterrupted, but the eastern part is cut up into fragments and thrown northwards by the granite-mass of Canigon.

MESOZOIC.—Dr. Carl Diener has published a monograph upon the geology of the Lebanon. He has worked out the numerous lines of faulting and flexuring which have occurred, mainly during the Miocene, in the strata, which, both in the Lebanon and Anti-Lebanon, are chiefly Cretaceous and Eocene Limestones. Jurassic beds occur in a narrow belt at the western base of Mount Hermon, which is to a great extent built upon the line of a great fault that coincides with its western base. The limestone beds of this mountain belong to the age of the Lower Chalk of Europe, and are disposed in the form of a low arch with a north-northeast axis. There are other faults on the south and east flanks. Doubtless the system of disturbance here is identical with that which caused the Jordan-Arabah depression; and the main line of fault of that depression enters the valley of the Leontes at the western base of Hermon. Here

the Lebanon Limestone and other Lower Cretaceous beds are nearly vertical and in contact with horizontal Upper Cretaceous beds. Dr. Diener throws some doubt on the former existence of glaciers in the district because he cannot find glacial striations.

Professor Owen recently read before the Geological Society of London a paper upon *Galesaurus planiceps* Owen. The characters of the skull and teeth have been brought to light. The reptilian nature of the fossil is indicated by the single occipital condyle and other features. The angle of the jaw is not produced beyond the articular element. In general shape and bony strength the mandible of Galesaurus resembles that of a mammal. The crowns of four upper molars are triangular, the base is flanked by a short cusp before and behind, and the corresponding margins are finely crenulate. The incisors are eight in each jaw and partially interlock. The canines resemble those of a mammal. No trace of successional teeth was found. The teeth are implanted firmly in sockets. The author remarked on the earlier reptilian character exhibited by the oolitic mammal Amphitherium and by the existing Myrmecobius. The specimens are from the Triassic of South Africa.

The Triassic age of the Hawkesbury sandstone formation, New South Wales, has been proved by the discovery of a Mastodonsaurus.

CÆNOZOIC.—Among some fossils from Wadi Halfa, Nubia, is an upper right-cheek tooth of an Equus of Pliocene type, allied to the group containing *E. sivalensis.*

M. A. Gaudry maintains the Miocene age of the Pikermi fauna, and M. Deperet has contributed to the French Academy a note upon the importance of the Pliocene beds in the south of France. It comprises twenty metres of drift, above which are one hundred metres of marine beds, while still higher there are one hundred and fifty metres of beds of continental formation. The beds of the Val d'Arno are above these, and have a very distinct fauna.

POSTPLIOCENE.—The Naulette jaw found in a cavern near Dinant (Belgium) is remarkable for its excessive prognathism. The study of it has led M. Topinard to conclude that in the age of the mammoth and tichorhine rhinoceros there were numerous mixed human races, to one of the lowest of which this jaw belonged.

M. A. Gaudry, who in July last called the attention of the French Academy to the exceptional riches of the grottoes of Mentone, in which had been collected not less than forty thousand shells belonging to one hundred and seventy-one species,

has recently stated that the same grottoes contain the bones of forty-two species of birds, fourteen of them birds of prey, the others the food-birds of the primitive race who inhabited the caves. One species only is extinct, but many have disappeared from the region they then inhabited. The quail, which is now common on the Mediterranean coasts, is seen in the Mentone grottoes.

The batrachians of the Mentone grottoes are a species of toad, which no longer exists in France, and in dimensions is near the large *Bufo agua* of South America, and a frog, while seven species of fish occur, one extinct and six still living. The extinct species belongs to Strophodus, a Jurassic genus of sharks. Among the recent species are the maigre, tunny, salmon, and trout. Altogether, in the six caverns once inhabited by quaternary man, M. Gaudry reports eight hundred and forty thousand fragments, vertebrate and invertebrate, belonging to one hundred and eleven species of the former category and one hundred and seventy-one of the latter.

RECENT.—Professor J. D. Dana, in a recent article in the *American Journal of Science*, concludes, in connection with the recent disturbances at Kilauea, Vesuvius, and Tarawera, that volcanic action must be attributed to the hydrostatic pressure of the column of lava; the pressure of vapors escaping in underground regions from the lavas, or produced by contact with them, acting either quietly or catastrophically; and the pressure of the subsiding crush of the crust forcing up the lavas in the conduit.

MINERALOGY AND PETROGRAPHY.[1]

Petrographical News.—The rocks occurring in equatorial Eastern Africa (Massai-Land) have been found by O. Mügge[2] to embrace granophyres, gneisses, mica schists, and amphibolites among the older rocks, and liparites, trachytes, nephelinites, nepheline-tephrites and basanites, limburgites, melilite-basalts, augite andesites and feldspathic basalts among the younger ones. The granophyres contain an augite with partings parallel to $\infty\breve{P}\infty$ and oP, hypersthene and hornblende, all of which are so closely and peculiarly associated that the author thinks they might be due to the solution in the granophyre substance of some foreign inclusion. The gneisses, schists, and amphibolites also contain a diallagic and an orthorhombic augite. Among the granular constituents of two specimens of amphibolite, prismatic crystals of scapolite were noticed. The porphyritic feldspathic constituent of the trachytes (acmite-trachytes) corresponds very closely to the soda-microcline of Förstner.[3]

[1] Edited by Dr. W. S. BAYLEY, Madison, Wisconsin.
[2] Neues Jahrb. fr. Min., etc., Beil. Bd., iv. p. 576.
[3] *Cf.* American Naturalist, Notes, June, 1885, p. 600.

Wollastonite and melanite, which were observed in some of the nephelinites, Mügge thinks must be looked upon as having crystallized directly from the magma of the rock itself, and not as the result of the solution of inclusions. Unfortunately, the author was not able to study these rocks in the field, so that their geological relations are not definitely known.——Bruno Doss[1] has recently made a very thorough investigation of the igneous rocks of Palestine, and as a result of his studies declares them to be labradorite basalts. Their olivine constituent occurs both in porphyritic crystals and in the ground-mass. The two generations are distinguished by the marked differences in their mode of alteration. The mineral of the first generation contains more iron than that of the second, and accordingly gives rise to decomposition products consisting principally of red iron compounds insoluble in acids, while the latter class are merely serpentinized. Twins of olivine were observed in which the twinning planes are $P\breve{\infty}$, and in less frequent instances ∞P. In three specimens pseudobrookite was detected.——The fact that quartz and olivine may occur in the same rock is given additional interest by the discovery in Northern California of a quartz-basalt. This rock is described by Mr. Diller[2] as possessing all the essential characteristics of ordinary basalts, with the addition besides of numerous grains of quartz, many of which are surrounded by a zone of glass and pyroxene. From the fact that quartz is also found in bombs, which must have existed as clots in the lava at the time of its eruption, Mr. Diller is forced to assume that the same magma which under ordinary conditions of temperature and pressure yielded olivine, under different conditions secreted quartz. This quartz-basalt is younger than the ordinary basalts of the region, just as the dacites are younger than the andesites. ——The origin of lithophysæ in the acid lavas of the Yellowstone National Park is the subject of a paper by Mr. Iddings[3] in a late number of the *American Journal of Science*. In it the author inclines to the theory first proposed by Von Richthofen, viz., that this structure is of aqueo-igneous origin, and was produced by the action of absorbed gases upon the molten glass, from which they were liberated during the crystallization consequent upon cooling. Mr. Iddings is led to this view by the facts (1) that the minerals found upon the walls of the lithophysæ (quartz, tridymite, and fayalite) are those which have been produced artificially only by aqueo-igneous methods, and (2) that the chemical composition of the substances of lithophysæ and of spherulites is essentially the same, and therefore the former cannot have been produced by the alteration of the latter.[4]——Chrustschoff[5] has isolated zircon

[1] Min. u. Petrog. Mitth., vii., 1886, p. 461.
[2] Amer. Jour. Sci., Jan. 1887, p. 45.
[3] Ib., Jan. 1887, p. 36.
[4] *Cf.* American Naturalist, Notes, Jan. 1887, p. 70.
[5] Min. u. Petrog. Mitth., vii., 1886, p. 423.

from gneisses, granites, trachyte, basalt, sanidine bombs, and graywackes, and has described the characteristic peculiarities of crystals obtained from these different sources. He has found that the crystals occurring in gneisses always present rounded contours, while those in granite are always defined by sharp crystal planes. He proposes to make use of this fact in distinguishing gneisses with granitic habit from true granites.

Mineralogical News.—*Kaliophilite* is the name proposed by Mierish[1] for a new mineral occurring in colorless needles in one of the Monte Somma bombs examined by him in the course of his work referred to in the March number of this journal. It is a potassium nepheline. An analysis yielded,—

SiO_2	Al_2O_3	CaO	K_2O	Na_2O
37.48	32.43	2.18	27.20	2.26

The author supposes that ordinary nepheline may consist of mixtures of the isomorphous molecules $K_2Al_2Si_2O_8$ and $Na_2Al_2Si_2O_8$, since this mineral always contains more or less potassium. The group of nephelines is now known to consist of at least three members, the third being the mineral eucryptite, discovered by Brush and Dana[2] among the alteration products of spodumene. ——*Scapolite.*—In no manner can the difference in the views of the two schools of mineralogical chemists be better learned than by an examination of the papers relating to the discussion now being carried on in Germany and Austria in regard to the nature of the scapolite group of minerals. In an article in the *Neues Jahrbuch*, Rammelsberg[3] gives his reason for considering this group of minerals as consisting of molecular combinations of normal- (meta-), half- (ortho-), and di- (bi-) silicates of sodium, calcium, and aluminium in certain definite proportions. *Sarkolite*, for instance, he regards as a molecular compound made up of the three ortho-molecules in the proportions $3Na_4SiO_4$, $27Ca_2SiO_4$, $10Al_4(SiO_4)_3$; and *Meionite*, from Mt. Vesuvius, as a similar compound, in which the meta-silicates are present in the proportions of one molecule to six of the ortho-silicates, as,—

$$6\left\{\begin{matrix}Na_4SiO_4\\ 6\left\{\begin{matrix}4Ca_2SiO_4\\ 3Al_4(SiO_4)_3\end{matrix}\right.\end{matrix}\right\} + \left\{\begin{matrix}Na_2SiO_3\\ 6\left\{\begin{matrix}4CaSiO_3\\ 3Al_2(SiO_3)_3\end{matrix}\right.\end{matrix}\right\} + 20NaCl.$$

Tschermak,[4] on the other hand, regards the members of this group (like those of the plagioclase group) as isomorphous mixtures of the two molecules $4CaO,3Al_2O_3,6SiO_2 = Ca_4Al_6Si_6O_{25}$ and $Na_8Al_6Si_{18}O_{48}Cl_2 = 3Na_2O,3Al_2O_3,18SiO_2 + 2NaCl$, which he calls respectively the meionite and mariolite molecules. By

[1] Tschermak's Min. u. Petrog., Mitth. viii., 1886, p. 156.

[2] Amer. Jour. Sci., III. xx., 1880, p. 257.

[3] Neues Jahrbuch f. Min., etc., Beil. Band, iv., 1886, p. 610; also Sitzb. Berl. Akad., Bd. 30, p. 589.

[4] Min. u. Petrog. Mitth., vii., 1886, p. 400.

the combination of these two molecules in different proportions the various members of the group are formed, and by calculation the proportionate amounts of each present in any given case can readily be determined from the amounts of calcium and sodium found by analysis.——*Bastonite*, a micaceous mineral characterizing certain sandstones and arkoses, is supposed by Renard to be very similar to vermiculite, which Tschermak regards as an altered phlogopite. Its analysis yielded Klement,[1]—

SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	K_2O	Na_2O	H_2O
36.91	20.04	20.01	3.73	trace	0.95	7.96	3.07	0.22	6.98

——According to the investigations of Nordenskiöld,[2] the peculiar fluid inclusions in Brazilian topaz, to which Dana gave the name "brewsterlinite," are, at least in some cases, inclusions of a hydrocarbon, probably of the naphtha group.——Schuster[3] has discovered that the *braunite* from the manganese mines of Jakobsberg, in Wermland, Sweden, is probably isomorphous in crystallization with hematite and ilmenite. Its analysis yielded Igelström,[4]—

SiO_2	MnO	FeO	MgO.CaO	PbO	O
8.7	80.23	1.33	0.95	8.65	8.17

If the iron, magnesium, calcium, and lead be supposed to replace manganese, the composition of the mineral may be represented by the formula $11Mn_2O_3.3MnSiO_3$, corresponding very nearly to the result reached by Rammelsberg in his analysis of the braunite from Elgersburg.

Crystallographic News.—Recent measurements of crystals of *vanadinite* from Pinal County, Arizona, have yielded Mr. Penfield[5] results agreeing closely with those obtained by Urba[6] in his investigations of Carinthian crystals. *Endlichite*[7] [$Pb_5Cl(AsO_4)_3 + Pb_5Cl(VO_4)_3$] from the Sierra Grand Mine, Grant County, New Mexico, was also examined. The axial ratio, as determined by Penfield, is $a:c = 1:.7495$. The presence of arsenic in the mineral seems to tend to increase very perceptibly the length of the vertical axis as compared with that of the pure vanadium mineral (in vanadinite $a:c = 1:.7112$).——The new forms 2O, 11O6, and 6O4 have been observed by E. S. Dana[8] on crystals of native *copper*. In the same paper the author describes crystals which, by development in certain directions, assume the rhombohedral symmetry. The twinning laws of copper are also investigated, and the article concludes with plates containing fifty-

[1] Min. u. Petrog. Mitth., viii., 1886, p. 1.
[2] Neues Jahrb. f. Min., etc., 1886, i. p. 242.
[3] Min. u. Petrog. Mitth., vii., 1886, p. 443.
[4] Annales des Mines de Wermland, 1884, p. 73.
[5] Amer. Jour. Sci., December, 1886, p. 441.
[6] Zeitschrift f. Kryst., iv. p. 353.
[7] American Naturalist, Notes, July, 1885, p. 709.
[8] Amer. Jour. Sci., December, 1886, p. 413.

four illustrations of copper crystals and crystal groupings.—— From new measurements of crystals of *hyalosiderite*, the iron-rich olivine, and *forsterite*, the pure magnesian variety, Max Bauer[1] has recalculated the axial relations of these minerals. For the first he finds $\breve{a}:\bar{b}:\dot{c} = .46815:1:.58996$; for the second, $\breve{a}:\bar{b}:\dot{c} = .46476:1:.58569$. On comparing these ratios with those obtained from measurements made on *fayalite*, the pure iron olivine, and other members of this series, the composition of which is known, it is found that an increase in the amount of the magnesium molecule present in any case is accompanied by a shortening of the $\breve{a}$ and $\dot{c}$ axes as compared with the $\bar{b}$ axis.——In the same article Bauer describes twinning lamellæ in massive *barite* from several localities in Germany. The twinning plane is $6P\infty$. He regards them as pressure twins like those found in calcite, cyanite, sphene, etc.

Miscellaneous.—In the January number of the *American Journal of Science*[2] Mr. G. F. Becker has an interesting article on "The Texture of Massive Rocks." The subject is treated theoretically, and in such a manner that a brief synopsis of it would be most unsatisfactory. Suffice it to state here that Mr. Becker supposes the formation of plutonic granitoid rocks to represent an extreme and highly exceptional case of neutral chemical equilibrium in a pasty magma, by the cooling of which they were derived. As a rule, however, he regards granular structure as characteristic of metamorphosed sediments.[3] Porphyrite structure is the natural result of slow cooling of a very fluid magma, and is merely the evidence of fractional crystallization of the various minerals. These conclusions are based on a theory of the solidification of minerals in accordance with certain laws of thermo-chemistry.[4]——In a letter to the *Neues Jahrbuch für Mineralogie*,[5] A. Schrauf explains his views on morphotropism and atometrie, which, so far as they relate to minerals, are briefly as follows. The form of crystallization of chemical mixtures depends principally upon the various amounts of their constituents. $MgSO_4 + 7H_2O$ (epsomite) crystallizes in the orthorhombic system, while $FeSO_4 + 7H_2O$ (melanterite) is monoclinic. Mixtures of $MgSO_4 + 7H_2O$ and $FeSO_4 + 7H_2O$ crystallize in the latter system until the proportion of magnesium in the mixture is to the amount of iron as three atoms to one atom $(3MgSo_4 + FeSo_4) + 7H_2O$, when it crystallizes in the orthorhombic system,—*i.e.*, the crystallization is determined by that substance which is in excess (by weight). In the compound $(3MgSo_4 + FeSo_4) + 7H_2O$ the Mg and

[1] Neues Jahrb. f. Min., 1887, i. p. 1.
[2] Amer. Jour. Sci., January, 1887, p. 50.
[3] *Cf.* American Naturalist, Notes, December, 1886, p. 1050.
[4] Amer. Jour. Sci., 1886, p. 120.
[5] Neues Jahrb. f. Min., 1886, i. p. 234.

Fe are to each other as 72 : 56, Mg is in excess, and the substance crystallizes as does $MgSo_4 + 7H_2O$. In compounds containing less Mg (as $2MgSo_4 + FeSo_4) + 7H_2O$, the proportions of Mg and Fe are as 48 : 56, and the crystallization is that of melanterite. Various conditions effect the crystallization of mixed bodies, but the most important of these, according to Schrauf's opinion, is the one mentioned above. If this law is found to be general in its application, the present views in regard to the dimorphism of many compounds belonging to the so-called iso-dimorphous groups will have to be modified.

BOTANY.[1]

Botanical Manuals for Students.—Nowadays we are urging students to collect and study plants from all the great groups, and thereby to familiarize themselves with the vegetable kingdom as a whole, but perhaps we too often overlook the difficulties which lie before them. Not the least of these is the want of systematic manuals in which descriptions of the genera and species may be found. It is all very well to tell a student that the name and technical description are of much less importance than is the knowledge of structure and habits. It is true, no doubt, but, for all that, there is need of such works in every laboratory, to serve *as guides*, if for no other purpose. Unfortunately for the American student, we are as yet poorly supplied with descriptive manuals. In the following list I have enumerated the classes (and in some cases the orders under the classes) of the several great branches of the plant kingdom, giving for each the name of a useful systematic manual. I have not attempted to make a list of the works of this kind which are *absolutely the best*, for too often such works are too expensive for the limited means of the botanical departments of many schools and colleges.

PROTOPHYTA.

MYXOMYCETES.—Cooke's Myxomycetes of Great Britain.

SCHIZOMYCETES.—Grove's Bacteria and Yeast Fungi.

CYANOPHYCEÆ.—[2] Cooke's British Fresh-Water Algæ, pp. 203–282, and, doubtfully, pp. 1–30.

ZYGOPHYTA.

ZOOSPOREÆ.—Cooke's British Fresh-Water Algæ, pp. 67 (Pandorina), 35–49 (Hydrodictyon, etc.), 135–145 (Confervaceæ); and Farlow's New England Algæ, pp. 41–44 (Ulvaceæ), and 61–98 (Phæosporeæ).

[1] Edited by Prof. CHARLES E. BESSEY, Lincoln, Nebraska.

[2] During the year the work on the "Fresh-Water Algæ of North America," by Francis Wolle, may be expected. When that appears it should be substituted for the "British Fresh-Water Algæ" wherever the latter occurs in this list.

CONJUGATÆ.—*Desmidiaceæ.* Wolle's Desmids of the United States.
Diatomaceæ. Van Heurck's Synopsis des Diatomées de Belgique.
Zygnemaceæ. Cooke's British Fresh-Water Algæ, pp. 74–110.
Mucorini.[1] Winter's Rabenhorst's Kryptogamen Flora.

OÖPHYTA.

ZOOSPOREÆ.—Cooke's British Fresh-Water Algæ, pp. 56–67 (Volvox, etc.), 132–134 (Sphæroplea).

ŒDOGONIEÆ.—Cooke's British Fresh-Water Algæ, pp. 148–177.

CŒLOBLASTEÆ.—*Vaucheriaceæ.* Cooke's British Fresh-Water Algæ, pp. 115–126.
Saprolegniaceæ.[1] Winter's Rabenhorst's Kryptogamen Flora.
Entomophthoreæ. Winter's Rabenhorst's Kryptogamen Flora, pp. 74–79.
Peronosporeæ. Farlow's Peronosporeæ of the United States.

FUCACEÆ.—Farlow's New England Algæ, pp. 99–104.

CARPOPHYTA.

COLEOCHÆTEÆ.—Cooke's British Fresh-Water Algæ, pp. 195–197.

FLORIDEÆ.—Farlow's New England Algæ, pp. 106–183.

ASCOMYCETES.—*Perisporiaceæ.* Bessey's Erysiphei.
Tuberaceæ. Cooke's Hand-Book of British Fungi, pp. 738–750.
Helvellaceæ. Cooke's Hand-Book of British Fungi, pp. 655–737.
Pyrenomycetes. Winter's Rabenhorst's Kryptogamen Flora, vol. ii.[2]
Lichenes. Tuckerman's North American Lichens.
Uredineæ. Burrill's Parasitic Fungi of Illinois.
Ustilagineæ. Winter's Rabenhorst's Kryptogamen Flora, pp. 79–131.

BASIDIOMYCETES.—Winter's Rabenhorst's Kryptogamen Flora, pp. 270–922, and Cooke's Hand-Book of British Fungi, pp. 1–376, and 409–413.

CHARACEÆ.—Halsted's American Species of Characeæ.

[1] The orders Mucorini and Saprolegniaceæ have not yet been reached in the publication of the "Kryptogamen Flora," but no doubt they will be soon.
[2] Not yet quite completed.

BRYOPHYTA.

HEPATICÆ.—Underwood's North American Hepaticæ.

MUSCI.—Lesquereux and James's Mosses of North America.

PTERIDOPHYTA.

Underwood's Ferns and their Allies.

PHANEROGAMIA.

There is no complete Phanerogamic Flora of the United States. The Gamopetalæ have been completed in Gray's "Synoptical Flora of North America." For the remaining flowering plants we must make use of the various local Floras, as follows:

For the Northeastern United States (*i.e.*, north of North Carolina and Tennessee, and west to the Missouri River), Gray's "Manual of Botany." For the Southeastern United States (*i.e.*, south of the preceding, and west to the Mississippi River), Chapman's "Flora of the Southern United States." Wood's "Class-Book" is intended to include all the Phanerogams of both the foregoing regions. For the region west of the Sierra Nevada Mountains, Watson's "Botany of California," or Rattan's "Popular California Flora." For the Rocky Mountains and the Plains, Coulter's "Manual of Rocky Mountain Botany." Strictly speaking, Coulter's Manual is intended to cover Colorado, Wyoming, Montana, Western Dakota, Western Nebraska, and Western Kansas, but its usefulness extends a couple of hundred miles farther in every direction. The Great Basin of Utah and Nevada and the Arizona-Texas region have no manuals as yet. For these regions Watson's "Catalogue of the Known Plants of Nevada and Utah" (*U. S. Geol. Explor. of the 40th Parallel*, vol. v.) and Rothrock's "Catalogue of the Plants collected in Nevada, Utah, Colorado, New Mexico, and Arizona" (*U. S. Geog. Surveys West of the 100th Meridian*, vol. vi.) will render good service.

Full titles of most of the foregoing works are given below, with approximate prices:

The Myxomycetes of Great Britain. M. C. Cooke. London, Williams & Norgate. $2.50.

A Synopsis of the Bacteria and Yeast Fungi. W. B. Grove. London, Chatto & Windus. $1.25.

British Fresh-Water Algæ. M. C. Cooke. London, Williams & Norgate. $22.00.

Marine Algæ of New England. W. G. Farlow (Rept. U. S. Fish Commission, 1879). Washington. $2.50.

Desmids of the United States. Francis Wolle. Bethlehem, Pa. $5.00.

Synopsis des Diatomées de Belgique. Henri van Heurck. Anvers. $50.00.

Rabenhorst's Kryptogamen Flora: Die Pilze. George Winter. Leipzig. Ed. Kummer. $16.00.

Enumeration of the Peronosporeæ of the United States. W. G. Farlow. *Botanical Gazette*, Oct. and Nov., 1883.

On Injurious Fungi: The Blights (Erysiphei). C. E. Bessey. Seventh Biennial Rept. Iowa Agricultural College, 1877.

Hand-Book of British Fungi. M. C. Cooke. London, Macmillan & Co. $12.00.

A Synopsis of the North American Lichens. Ed. Tuckerman. Boston, S. E. Cassino. $3.00.

Parasitic Fungi of Illinois: Uredineæ. T. J. Burrill. Bulletin Ill. State Laboratory of Nat. History, vol. ii., 1885.

Classification and Description of the American Species of Characeæ. B. D. Halsted. Proc. Boston Soc. Nat. History, vol. xx., 1879.

Descriptive Catalogue of the North American Hepaticæ North of Mexico. L. M. Underwood. Bulletin Ill. State Laboratory of Nat. History, vol. ii.

Manual of the Mosses of North America. L. Lesquereux and T. P. James. Boston, Cassino & Co. $4.00.

Our Native Ferns and their Allies. L. M. Underwood. Bloomington, Ill. $1.25.

Synoptical Flora of North America. Asa Gray. New York, Ivison, Blakeman, Taylor & Co. $6.00.

Manual of the Botany of the Northern United States. Asa Gray. Same publishers. $2.00.

Flora of the Southern United States. A. W. Chapman. Same publishers. $4.00.

Manual of the Botany of the Rocky Mountain Region. J. M. Coulter. Same publishers. $1.85.

Class-Book of Botany. A. Wood. New York, Barnes & Co. $3 50.

Botany of California. S. Watson. Cambridge, Mass., Welch, Bigelow & Co. $10.00.

A Popular California Flora. V. Rattan. San Francisco, Bancroft & Co. $1.00.

The two government reports (Watson's and Rothrock's) cannot probably be obtained from the government offices any longer. They may be bought of second-hand dealers for from $3.00 to $5.00 each.—*Charles E. Bessey.*

The Eighteenth and Nineteenth Centuries of North American Fungi.—About the middle of March these two centuries were received by subscribers from the hands of the authors, Messrs. Ellis and Everhart. Century XVIII. is notable for the great number of difficult micro-fungi which it contains. Thus,

of the genus Cercospora there are specimens of thirty-four species; of Septoria, twelve; of Phyllosticta, seven; and of Sphærella, four. The larger fungi are represented by fine specimens of half a dozen Polypori. Trametes, Hydnum, Radulum, Grandinia, Merulius, Hymenochæte, Stereum, Corticium, Næmalelia, and Exobasidium are represented by one or more species each,—that of the genus last named being the striking *E. discoideum* of Ellis, found on "the under-side of living leaves of *Azalea viscosa*."

Century XIX. is mainly devoted to the Uredineæ, there being no less than twenty-three species of Æcidium, twenty-eight of Puccinia, and sixteen of Uromyces, besides eight more of various genera, making a total of seventy-five. The remaining species are divided among eight or nine genera, of which Ustilago includes six, Peronospora three, Cystopus two, and Entomophthora two. It is scarcely necessary to say that the specimens are highly satisfactory.—*Charles E. Bessey.*

Tomato-Rot.—Dr. J. C. Arthur has been studying tomato-rot, and ascribes that observed in 1886 to fermentation. In the "Fifth Annual Report of the New York Agricultural Experiment Station," he says, "The fermentive action is evidently not begun until the resistance of the living tissues is greatly reduced or entirely lost. This may be brought about in several ways. All fruit reaches this condition of inability to resist the inroads of disease-germs, or of germs of disintegration, when it becomes fully ripe,—literally dead-ripe. The condition may be prematurely brought on by anything which decreases the vigor of the plant, and thus enfeebles and shortens the life of its ripening tissues. A marked, and from several points of view an interesting, example of the early and extensive rotting of ripe fruit in plants constitutionally debilitated by propagation for three seasons from seed successively selected from the feeblest plants of the preceding year is recorded by Mr. Goff, in which finally half the ripe fruit prematurely rotted. This kind of decay is very appropriately called 'soft rot,' and is well described by Mr. Goff as follows: 'The fruit becomes soft, and collapses without changing color; the skin finally bursts, permitting the contents to flow out, when it dries without detaching itself from the stem.' If the fruit rests upon the ground it often cracks open, and the exposed surface becomes speedily covered with a white, velvety growth, composed of yeast and *Oidium lactis*, which for a considerable time prevents the contents from escaping. This white growth, with the associated bacteria, is only a more obvious development of the active agents of fermentation which destroys the fruit."

Dr. Arthur insists upon the necessity of discriminating between the "soft rot" of ripe fruit and the other kinds which chiefly

affect green fruit, and suggests that one means of avoiding the former "is to maintain the health and increase the vigor of the plants by judicious breeding."

Botanical News.—Fascicle V. of Millspaugh's "American Medicinal Plants" was delivered to subscribers a month or two ago. Like the preceding fascicles, this one contains thirty plates, all of which are well done.——Professor Penhallow's "Mechanism of Movement in Cucurbita, Vitis, and Robinia" ("Proc. and Trans. Royal Soc. of Canada," vol. iv., 1886) treats of the tendril-movements of the first and second, and leaf-movements of the last. Three plates accompany the paper.——The "Additional Notes upon the Tendrils of Cucurbitaceæ" (*Can. Record of Science*, October, 1886), by the same author, continues the work in the order mentioned. Twenty-two species belonging to nine genera were under observation. The principal inquiry in this paper was that relating to the strength of tendrils, or of the spirals which they form.——B. D. Jackson gives an account, in the March *Journal of Botany*, of the new "Index of Plant Names," now under way. It is the intention to make a complete index of all genera and species of Phanerogams, so as to give "a view of the actual state of botany at the end of 1885."——The principal article in the March *Botanical Gazette* is one by Dr. Gray on Delphinium. It is an "essay at a rearrangement of our species," and is submitted in the hope of eliciting from botanists such observations and criticisms as will either confirm or invalidate the characters used.

ENTOMOLOGY.[1]

The Joint-Worm in New York.—Twenty-five years ago *Isosoma hordei* did a great amount of injury to wheat, barley, and rye in this State; in some localities the yield was reduced fully fifty per cent. But during recent years this insect has attracted almost no attention. The present generation of farmers do not even know the characteristic signs of its ravages. There are, however, indications that the causes that have kept it in check, whatever they may be, are ceasing to be effective. And it is more than probable that unless care is exercised by the grain-growers of the State, there will be a repetition in the near future of the great losses of a quarter-century ago. The insect has already become very abundant in the northern part of Tompkins County. But I am not aware that the farmers even suspected its presence until their attention was called to it at a recent farmers' institute. The proprietors of a paper-mill at Ithaca have found that the straw received from certain localities is unfit for making paper, owing to the solidification of considerable portions of it by the injuries of this insect. In one lot of straw received from

[1] This department is edited by Prof. J. H. COMSTOCK, Cornell University, Ithaca, N. Y., to whom communications, books for notice, etc., should be sent.

a packer at Lake Ridge one-twenty-fifth of the straws were infested, and the straw received from another locality was very badly injured. The matter is certainly worthy serious attention. Articles published by Cook and by Riley in the *Rural New-Yorker* some time since indicate that this pest is also increasing unduly in Michigan and in Ohio.—*J. H. Comstock.*

Relations of Ants and Aphids.—The great benefits derived by ants from plant-lice have been long known. Many species of ants obtain a considerable proportion of their subsistence from Aphids and allied insects, honey-dew constituting the chief part of their food. But in what way the plant-lice profit by this association is probably only partially understood. The slight amount of protection afforded by the ants in occasionally driving insectivorous insects away from colonies of Aphids can hardly be sufficient to account for the development of the apparatus for excreting honey-dew. The fact, now well known, that certain ants collect and preserve in their nests the eggs of Aphids during the winter, indicates that there are more important relations between the two groups of insects than appear at first sight. And this is confirmed by the recent discovery by Professor Forbes that the corn plant-louse (*Aphis maidis*) is strictly dependent on an ant (*Lasius alienus*). This ant in the early spring mines along the principal roots of the corn, collects the wingless lice that have hibernated in the earth and conveys them into its burrows, and there watches and protects them. Experiments indicate that the plant-lice are unable to establish themselves upon the roots of corn without the aid of ants, even when placed in great numbers at the base of the hill of corn.—*J. H. C.*

Dipterous Larvæ in Sarracenia purpurea.—Dr. Riley has recorded (*Canadian Entomologist*, vol. vi. p. 209) some interesting observations concerning a flesh fly (*Sarcophaga sarraceniæ* Riley), which lives in its larval state in the liquid contained within the leaves of the Southern pitcher-plants, *Sarracenia variolaris* and *S. flava*, subsisting upon the dead bodies of the insects caught by the plants. It may be of interest to record that the same or a similar species inhabits the watery liquor contained within the leaves of the common Northern pitcher-plant, *S. purpurea*. While taking a vacation in the pine-wood regions of Northern Michigan (Missaukie County) last August, I found this interesting plant very abundant in the swamps and marshes. About ten per cent. of the leaves contained larvæ that agree with the figure and description of the larva of *S. sarraceniæ*, but unfortunately I was unable to rear the fly. Many of the leaves contained circular holes, out of which some of the larvæ had doubtless emerged to pupate. When the water contained within the leaves was emptied into a glass vessel, these Sarcaphagous larvæ could

be easily seen swimming about in search of food and attaching themselves to any plump carcass that came in their way. When placed in ordinary commercial alcohol they would live between three and four hours.

As is well known, the prevailing color of the leaves of this plant is a livid red, and it is worthy of note that the commonest of the larger insects found within them belonged to that family which is said to be especially attracted by this color,—the Vespidæ or wasps. It is probable, also, that this color may have some attractive influence over various two-winged flies,—including the parents of the larvæ mentioned above.—*Clarence M. Weed, Champaign, Ill.*

Bacteriological Studies in Arthropods.—M. E. G. Balbiani[1] finds that saprophytic bacilli, when inoculated into the blood, are pathogenic for a large number of Arthropods. Death follows in from twelve to forty-eight hours, according to external temperature, number and origin of spores, size, age, and susceptibility of the subject. They die with all of the symptoms which characterize the disease known as "flacherie" in silk-worms, a malady determined by the development of various species of bacteria in the organism. Insects of the different orders are not equally susceptible; those which contain a small quantity of blood in proportion to the mass of the body (Lepidoptera, Diptera, Hymenoptera) are killed more rapidly and surely than those in which the relative proportion of blood is greater, and (above all) in which the blood is richer in corpuscles; this is specially the case with the Gryllidæ.

The resistance is due to the corpuscles seizing by their pseudopodia on the bacilli, and to the elements of the pericardial tissue, which seize on and destroy the poisonous organisms. This identity in mode of action is ascribed to the genetic relation which exists between the two kinds of cells. Death is delayed if the spores are kept for more than six years in a state of desiccation.—*Jour. Roy. Micr. Soc.*, 1887, p. 70.

Ants and Ultra-Violet Rays.—Whilst Sir J. Lubbock considers that ants perceive the ultra-violet rays by means of their eyes, Graber finds, by removing these organs from Tritons, etc., that it is by the skin that these rays are perceived. Prof. A. Forel has made experiments in order to answer the question whether ants perceive these rays by means of their eyes, or by the skin; and he finds that it is mainly by the former organs, but admits that "photodermatic" perception may accompany the optic sense. *Camponotus ligniperdus* and *Formica fusca* served for his experiments, and a "solution d'esculine" was used for absorbing the ultra-violet rays.—*L. c.*, p. 73.

[1] Comptes Rendus, ciii. (1886) p. 952–54.

Light-Perception by Myriapods.—Fourteen years ago Pouchet showed that muscid larvæ without eyes were still sensitive to light, and Graber (as indicated above) has recently in some striking experiments extended the same conclusion. Prof. F. Plateau[1] gives a careful historical survey of what is known in regard to light-sensitiveness among invertebrates, and reports the result of his own researches on blind Myriapods.

His method of experiment was manifold. That of Pouchet, that of Graber, and two other modifications were employed in order to determine whether the blind Myriapods were able to perceive light, while in another series M. Plateau sought to determine the rapidity of perception.

His chief results are summed up as follows: The blind chilopod Myriapods perceive the daylight, and are able to choose between it and darkness; in the chilopod Myriapods provided with eyes, and in those without these organs, a considerable time must elapse before the animals perceive that they have passed from relative or complete obscurity to daylight; the length of this period is not greater in the blind Myriapods than in those with eyes; owing to the general slowness of perception, blind Myriapods, although sensitive to light, may cross a dark space of small extent without perceiving it, or being able to find it again when they have left it; the rapid search for a hole in the soil is explicable, not only as a flight from light, but as an expression of the necessity for a damp environment, with which the greater part of the body may be in direct contact.—*L. c.*, p. 76.

The Hessian Fly in England.—At a meeting of the Entomological Society of London, held December 1, Miss Elenor A. Ormerod read a paper and exhibited specimens of the Hessian Fly (*Cecidomyia destructor*) taken in Hertfordshire, England. The specimens undoubtedly belonged to this species, as they had been compared with authentic American and Austrian examples.

Function of the Palpi in Chilopods and Spiders.—Felix Plateau has recently investigated the question of the function of these organs, and has published the account of his experiments in the *Bulletin* of the Zoological Society of France (1886, p. 512). He reviews the previous opinions on the subject, and experimentally demonstrates that in Lithobius, etc., they are used neither as organs of sense nor in the capture of food. He assigns them the function of cleaning the antennæ. The so-called palpi in the male spiders, as is well known, serve to convey the spermatozoa to the female reproductive organs. Of the functions of these organs in the females almost nothing is known. Some have regarded them as sensory, and have described organs of smell upon

[1] Jour. de l'Anat. et de la. Physiol., xxii. (1886) pp. 431–57.

them. Some consider them as of use in the capture of food, and others think they play a part in the building of a web. Plateau's experiments were upon five species belonging to as many genera. The results were that these species, when deprived of their palpi, spun normal webs and captured their prey as well as their unmutilated fellows. He concludes that these appendages are to be placed, like those of the mandibulate insects, in the category of useless organs. His experiments on scorpions and Phalangium gave negative results, as these forms refused to feed. Plateau thinks that the primitive form from which both fossil and recent Arthropods have sprung varied but little from an embryonic type. The segments of its body were all similar in shape and size, and each bore a pair of many-jointed appendages. In development some of the anterior segments became modified, the basal joints of the appendages became concerned in manducation, while their distal joints, now relieved of ambulatory functions, are in various stages of atrophy and have lost their original meaning. In some cases (Arachnida) they have taken a new function.

Necrology.—M. Maurice J. A. Girard died the 8th of September last, in his sixty-fourth year, at Lion-sur-Mer (Calvados). Dr. Girard was the author of several important entomological works. The chief of these is his "Traité Elémentaire d'Entomologie." This was completed only in 1885, and comprises three large volumes and an atlas of many plates.

M. Jules Lichtenstein died on the 30th of November last, at Montpellier, France, at the age of sixty-eight. M. Lichtenstein was a vineyard proprietor, and made a special study of the habits of the Grape Phylloxera, and of allied Aphids. He was one of the most prominent and original of the French writers on these subjects.

Edgar, Freiherr von Harold, died August 1, 1886, at Possenhofen, Bavaria. He is best known to American entomologists as one of the authors of the "Catalogus Coleopterorum" and editor of the "Coleopterologische Hefte."

Entomological News.—The "First Supplement to the List of Coleoptera of America, North of Mexico," by Samuel Henshaw, is published in the *Entomologica Americana*, vol. ii., No. 11. The names of two hundred and thirteen additional species are given, and many changes indicated.——The *Canadian Entomologist* for December contains the conclusion of an important article by Grote on the Geographical Distribution of North American Lepidoptera. Several very interesting tables are given.——At a meeting of the Entomological Society of London on December 1, Mr. Poulton exhibited the bright green blood of the pupa of *Smerinthus tiliæ*, which is one of many Lepidopterous pupæ

possessing a chlorophyll-like pigment (called metachlorophyll by Mr. Poulton) in the blood. By means of a micro-spectroscope the most characteristic absorption-band of the pigment, together with its resemblance to chlorophyll, was shown.——The well-known American entomologist, Mr. A. R. Grote, has been presented by His Highness the Duke of Saxe Coburg-Gotha (brother-in-law of Her Majesty the Queen) with the large Silver Medal, *Princeps Musarum Sacredos*, for Art and Science.——The January number of the *Wiener Ent. Zeit.* contains the second and concluding part of the Supplement to the Monograph of the Œstridæ by Dr. Brauer. In this part the characters of the fully-developed larvæ are discussed, and an analytical table of the genera given. There is also an analytical table for determining the genera of the adult insects.

ZOOLOGY.

Fauna of Novaia Zemlia.—Anton Stuxberg contributes to the fifth volume of the scientific results of the "Vega" expedition a review of the fauna of Novaia Zemlia. Of the sixteen mammals he enumerates two lemmings, one wolf, two foxes, the polar bear, and the reindeer as terrestrial; all the others are marine. The birds number forty-one. The fishes are not enumerated, but one is struck with the relative proportions of the different orders of Hexapods. Of these the Diptera number eighty-two, the Hymenoptera forty-six, and the Collembola sixteen out of a total of one hundred and fifty-four. The only Myriapod is a species of Lithobius. The Arachnids number forty-eight. Of the Crustacea only the Malacostraca are included. Of these there are ninety-six, sixty-one of this number being Amphipods. The Chætopods are one hundred and twenty-three in number, the true Molluscs one hundred and twenty, the Echinoderms thirty-seven. The total is seven hundred and forty-two species.

Pelagic Fauna of German Lakes.—Dr. Otto Zacharias read a paper at the late meeting of German naturalists and physicians in Berlin on the pelagic fauna of the North German lakes. The results of the exploration of fifty-six bodies of water were that there was a great similarity between their pelagic fauna and that of the Swiss and Northern Italian lakes. Some novelties were obtained: a new species of Ceriodaphnia, two of Bosmina, etc. The catalogue of his collections shows that there is a considerable similarity between these North German lakes and those of our Northern States, so far as pelagic invertebrates are concerned.

The Structure of Fungia.—Mr. Gilbert C. Bourne, who has been enabled by a grant of funds to visit the East Indies, gives in the January number of the *Quarterly Journal of Microscopical Science* (xxvii. p. 293) an account of the structure of a species of

mushroom coral occurring at the island of Diego Garcia. He did not succeed in finding the budding phase which has been described by Moseley, nor did he find any ova or spermatozoa. He gives somewhat detailed accounts of the soft parts, and shows that in these forms the tentacles are arranged in circles, there being seven circles in his species which correspond to the seven orders of septa. In describing the internal structure Mr. Bourne has coined the term mesoglœa for the third layer which separates the ectoderm and entoderm in all Cœlenterates. This layer is frequently called mesoderm, but it is far from proven that it is homologous with the layer called by that name in the higher Metazoa. The new term signifies middle jelly, and hence corresponds to the terms Gallertsubstanz and Gallertanlage of the Germans. The mesenteries are described, together with the mesenterial filaments, which, by the way, our author has not seen protruded from the cinclides in the species studied by him. In the endoderm he found peculiar masses of rounded nucleated cells, which, from their turning blue when treated with iodine, he regards as symbiotic algæ. His observations on the relation of the animal to the skeleton are regarded as confirmative of Von Koch's views of the formation of the latter.

The Life-History of the Hydromedusæ.—Under this title Dr. W. K. Brooks presents an extensive paper in the third volume of the *Memoirs of the Boston Society of Natural History*, illustrating his points by eight plates. He describes the life-histories of Cunocantha, Liriope, Turritopsis, and Eutima, four genera which are taken as representatives of as many groups of Hydromedusæ. From these the author arrives at the same conclusions as Böhm and Claus: that the medusa form is primitive, the hydra condition being a secondary development in the phylogeny of the Hydrozoa; a view diametrically opposite from that usually held. The various types of alternation of generations exhibited by these forms are placed in their proper sequence, and it is pointed out that, on the supposition that the primitive hydrozoan had a hydra-like condition, the modifications exhibited are utterly inexplicable, while, if the reverse be assumed, these alternations are readily seen to be the results of a free swimming ancestral stage. The existence of a true gastrulation in the Cœlenterates is questioned. A critical review of the literature of the development of the Hydromedusæ is given.

Turning Hydra inside out.—Trembley's oft-described experiment of turning the fresh-water Hydra inside out has but rarely been repeated, Professor Mitsikuri, of Tokio, being the only person who had been successful until a recent date. According to the accounts, the Hydra in this condition lived as well as before, its digestive layer functioning well as skin, while the skin took

upon itself the capacity of assimilation. Recently M. Nussbaum took up the problem, and, according to his account as presented in the *Biologisches Centralblatt*, the layers do not thus change place. There appears, indeed, an ectoderm, but this arises, not from an alteration of the endoderm, which has taken an external position by the operation of turning inside out, but by a growth of ectoderm from that of the basal pore and from the tentacles. He further maintains that ectoderm is always ectoderm, and endoderm can never be modified into any other layer. In regard to the reproduction of lost parts described by both Baker and Trembley, as well as many later observers, Nussbaum says that both layers must be present in order to have the missing portions reproduced.

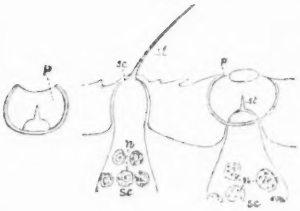
Renal Organs of Invertebrates.—Dr. McMunn has recently been investigating the subject of so-called renal organs in various molluscs as well as in the cockroach. The method was to boil the suspected organ in distilled water to dissolve the uric acid or urates. The solution was then evaporated, extracted with absolute alcohol, and then the residue was boiled again in water, filtered, and to the filtrate acetic acid was added in excess, and, after some hours' standing, crystals of uric acid and urates were distinguished under a one-fifth objective. Other chemical tests were applied and with the same results. The conclusion was that the so-called urinary or Malpighian tubules of insects and the nephridia of Limax and Helix are in reality urinary in function, as has been heretofore believed.

Migration of Frogs.—A peculiar migration of frogs takes place in the valley of the Red River of the North. The water of this river is green, like that of the Great Lakes, and the bottom is composed of soft clay several feet thick, which the frost never penetrates. To the west of the river, in Dakota, are numerous prairie sloughs, which freeze in winter. The frogs hibernate in the river bottom during winter, but every spring the entire army migrates to the sloughs, returning *en masse* in the fall. I used to regard the exaggerated newspaper accounts of these migrations as fictions; but last autumn, in Fargo, I saw the frogs hopping towards the river in large numbers and the citizens gather them for a two-weeks' feast. The river is very low and the banks very dry in summer, and the frogs are obliged to migrate or die of starvation, as their favorite fly loves water-plants.—*W. H. Ballou.*

Brazilian Reptilia.—Professor E. D. Cope recently read a paper on a collection made by Mr. H. H. Smith near Cuyabá, in the southern interior of Brazil. He derived from it a good many interesting results, especially to the knowledge of Geo-

PLATE XV.

8.



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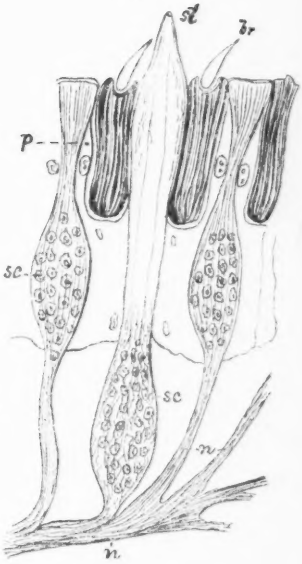

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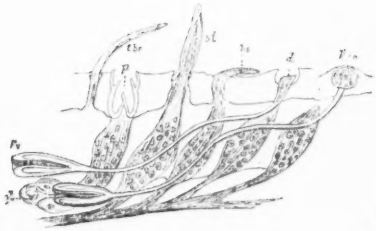

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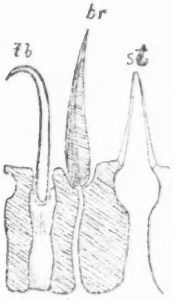


12.

ORGANS OF SMELL IN INSECTS.

graphical Distribution. Such are the great extension of the range of the anurous genus Prostherapis among Batrachia, of Anolis and Scartiscus among lizards, and of Rhynchonyx and Dirrhox among snakes. The rediscovery of a few species brought from the same region a half-century ago by the Austrian Johann Natterer is of considerable interest. Such are the species *Paludicola nattereri* and *Philodryas nattereri* Steind. Other rare species only seen in this collection for the second time are the *Rhynchonyx ambiniger* Peters, *Rhadinæa occipitalis* Jan., *Leptognathus turgida* Cope, and *Scartiscus caducus* Cope. The number of species known and previously unknown is as follows:

	New.	Total.
Batrachia	9	18
Lacertilia	0	15
Ophidia	3	29
	12	62

The Relative Weight of the Brain of Regulus satrapa and Spizella domestica compared to that of Man.—In the notices given by different writers on the relative weight of the brain to that of the body in different animals man has been given the foremost position. Thus, Landois[1] says the elephant has *absolutely* the heaviest brain, but man has *relatively* the heaviest brain. Surely this writer must have overlooked the little golden-crested kinglet and chipping sparrow, as the following facts seem to indicate. Two adults of the above-named specimens, which were taken in their native habitat last summer, were weighed with a view of comparison, with these results:

	Body.	Brain.
Golden-crested kinglet (*Regulus satrapa*)	97½	$4\frac{3}{10}$
Chipping sparrow (*Spizella domestica*)	173½	7½

Designated in grains.

As generally stated, man's brain weighs $\frac{1}{40}$ of that of the whole body. So far as the above figures show, the comparison bears out the following: the kinglet's brain weighs $\frac{1}{22}$, the sparrow's brain $\frac{1}{23}$, or nearer $\frac{2}{45}$, of that of the entire body respectively, the kinglet consequently having *relatively* the heaviest brain.—*Joseph L. Hancock, Chicago, Ill.*

Zoological News. PROTOZOA.—Dr. A. C. Stokes, of Trenton, N. J., describes eleven new species of American fresh-water Infusoria in the February number of the *Journal of the Royal Microscopical Society*, illustrating the same with a plate. Dr. Stokes thinks that identical species of Infusoria are not often found in the fresh waters of both the Old and the New Worlds, in which he will not receive the unanimous support of other workers in the same field.

[1] Landois, Phys., second ed., p. 706.

So-called eyes have often been described in the Protozoa. The latest instance is that of *Gymnodinium polyphemus*, described by Pouchet at a recent meeting of the French Academy. In this species of Flagellate there is described a strongly-refringent lens seated in a cup of black or red pigment. The lens arises from the fusion of several refractive globules and the pigment-layer or choroid from the similar coalescence of pigment-granules. The animal, in swimming, always moves "eye" forwards.

SPONGES.—Students of the sponges are under a heavy debt to Dr. G. C. J. Vosmær, who has just completed the volume on the Porifera in Bronn's "Klassen und Ordnungen der Thierreichs." This work forms the only general account of the sponges, and will form a valuable book in the library of every naturalist.

Carter claims that the sponges recently described from the fresh-water fauna of Central Europe and Southern Russia as belonging to the genera Dosilia and Ephydatia in reality are members of the genus Carterius originally described by Mr. Potts from Fairmount Park, Philadelphia.

CŒLENTERATA.—The reef-corals of the "Challenger" Expedition are described in vol. xvi. of the Reports by J. J. Quelch. The collection contained two hundred and ninety-three species, seventy-three of which, all but two from the Pacific and Indo-Pacific, are described as new. The author merges the Rugosa in the Madreporia Aporosa. Tabulæ are present in some Astræids, absent in some Rugosa; some Cyathophyllidæ have no indication of a tetrameral type, while in some Astræids the septa are not multiples of six; the rugose character of only two sizes of septa is present in some Astræidæ and absent in some Rugosæ, etc. *Manicina areolata*, an undoubted reef-building coral, was found in Simon's Bay, at a depth of from ten to twenty fathoms, and at a temperature of 65° F. Eight species of Millepora are described in an appendix.

Mr. Guppy brings forward in *Nature* some observations which tend towards the conclusion that atolls and barrier-reefs owe their appearance at the surface to a movement of elevation. Most of the coral reefs and shoals are arrested at from five to twenty fathoms below the surface, and Mr. Guppy believes that they cannot come within the range of the constructive power of the breakers without the aid of an elevatory movement. To the breakers he (with Semper) ascribes the atoll form, the convexity being towards the prevailing currents. Large atolls begin to assume their shape below the surface. He claims to have independently worked out the same conclusion to which Le Conte arrived with regard to the Floridan reefs,—viz., that a barrier-reef is caused by a belt of growing coral limited on one side by the muddiness and on the other by the depth of the water. Under favorable conditions reef-corals will thrive at depths of

fifty to sixty fathoms. This accounts for the depths of some lagoons.

ECHINODERMS.—Messrs. Danielssen and Koren have described *Hyaster mirabilis*, an Asterid with a central dorsal appendage, generally erect, but capable of motion. The describers conjecture this to represent a larval stage of the Crinoidea, and suggest that further investigations may tend to prove that the Asteridea are developed from the Crinoidea. They also believe that all specimens of cluster-polyps yet found are mere varieties of *Umbellula encrinus*.

Fossil remains of Holothurians are rare. Pocta describes some fenestrated plates from the Cretaceous of Bohemia, which he regards as belonging to the integument of some holothurian allied to Psolus. His paper may be found in vol. xcii. of the *Sitzungsberichte* of the Vienna Academy.

WORMS.—Marion describes two species of Balanoglossus in the *Archives de Zool. Exp.* (iv., 1886). One, which he calls *B. hacksi*, is from Japan; the other, *B. talaboti*, is from the Mediterranean. His descriptions are accompanied by many notes of the minute structure, but he does not express an opinion as to the systematic position of these forms. He alludes to the wide distribution of the genus as indicative of its antiquity, species being known from the North Sea, the west coast of France, the Mediterranean, Liberia, the Red Sea, Japan, the eastern coast of the United States, and Brazil. The cartilaginous support of the proboscis (Bateson's notochord) bears a marked histological resemblance to cartilage as found in the Vertebrates.

In the same number Poirier has a paper on the Diplostomatidæ, describing the structure of some of these parasites taken from the intestines of various Crocodilia. A detailed account is given of *Polycotyle ornata*, a parasite in the common alligator (*A. lucius*) of North America, which the author thinks should be placed with this family rather than with the Polystomidæ, where it had previously been placed.

Mr. E. C. Bousfield gives a full account of the habits and of the best methods of observing the genus Dero, which differs from the Naiades in having a respiratory apparatus at the end of the tail. He diagnoses seven species, of which four are new.

Mr. J. J. Fletcher has described nine new earth-worms from Australia,—seven Perichætæ, one Cryptodrilus, and one Digaster. The Perichætæ are separable into two groups, one characterized by the possession of complete circles of setæ, and by the presence of two cæcal appendages of the large intestine in segment xxvi.; the other by incomplete circles of setæ and no cæca.

The second number of the *Journal of the Trenton* (N. J.) *Natural History Society* contains an anonymous "key" to the genera

and species of North American Fresh-Water Polyzoa, illustrated by a plate of figures copied from various sources.

In the same publication Dr. T. O. Stevens gives a key to the genera and species of Rotifers recently described in the extensive monograph by Hudson and Gosse. In this connection it may be noted that no sooner is this large work completed than Mr. P. H. Gosse, one of the authors, describes (*Journal Royal Micros. Society*, February, 1887) twenty-four new species of Rotifera, illustrating them by two plates.

At the Linnæan Society Mr. S. O. Ridley recently described *Lophopus lendenfeldi*, from near Sydney, N. S. W. This is the fourth species of fresh-water polyzoon on record from Australia.

MOLLUSCS.—Part XVI. of the magnificent folio report of the Norwegian North Atlantic Expedition is devoted to the second installment of Herman Frieles's account of the Mollusca. It deals with the Pleurotomidæ, Cancellaridæ, and Brachiopods, and is illustrated by six plates. The work will prove invaluable to systematic students of the molluscan fauna of the North Atlantic.

Vol. xv. of the "Challenger" Reports is largely taken up with the Rev. R. Boog Watson's report on the Scaphopoda and Gasteropoda. About thirteen hundred species were collected. The Chitons collected by the "Challenger" were few. The really deep-sea forms belong to Leptochiton, of which four species were found, two of them new. These were taken at depths of from sixty to two thousand three hundred fathoms.

Mr. E. Heyle, in his report on the Cephalopoda of the "Challenger" Expedition, enumerates three hundred and eighty-eight species and sixty-eight genera, of which seventy-two species were met with. Thirty-two of these are described as new. None of these belong to the monster cuttles. Four new genera and one new species are established. Cirroteuthis has three species added, the largest, *C. magna*, eleven hundred and fifty-five millimetres long. In the new genus Amphitretus the mantle is fused with the siphon in the median line, so that there are two openings into the branchial sac. *A. pelagicus* was taken near the Kermadec Islands. Twenty kinds of Octopus were found, eleven of which are described as new. Ten new species are added to Sepia, and specific characters are found in the shell or sepiostaire. Two species of Taonius were found. *T. suhmi* was taken for a Clionid Pteropod by Willemoes-Suhm, and described as a new genus of Cephalopoda by Lankester.

The Marseniadæ are a family the types of which were the *Helix perspicua* of Linnæus and the *Bulla latens* of Müller. The species occur in all seas, and have the shell either altogether enveloped in the mantle or very partially exposed. Six genera and thirty-three species are recognized in vol. xv. of the "Challenger" Reports, eleven of them new.

CRUSTACEA.—Pelseneer gives a list of one hundred and ninety-seven crustaceans actually known from Belgium.

Dr. W. K. Brooks's description of the "Challenger" Stomatopods has been reprinted, with other papers, in the volume of "Selected Morphological Monographs" just issued by the Johns Hopkins University. It is a paper of one hundred and sixteen quarto pages and sixteen plates. The collections embraced only fifteen species of adults, but of these eight proved to be new. Together with these is described a new mantis-shrimp from North Carolina,—not embraced in the "Challenger" collections,—under the name *Lysiosquilla* (*Coronis*) *excavatrix*. The great value of the paper lies in its wealth of descriptions of larval forms by which Dr. Brooks has been able to rearrange the genera on a phylogenetic basis. In this connection it may be mentioned that last summer Dr. Brooks was successful in obtaining the eggs of a species of mantis-shrimp (Gonodactylus) in the Bahamas. Unlike all other crustaceans, these forms deposit their eggs, and do not carry them about with them. In this case the eggs were laid in the cavities of the coral-rock, and readily hatched in captivity.

Mr. Pascoe recently exhibited at the Linnæan Society specimens of a Balanus in which several individuals had united their shells into a common tube, and where the outer valves of each animal had lengthened, forming a series of irregular subsidiary tubes radiating from the apex of the primary one.

ARACHNIDA.—Nalepa has a long and well-illustrated paper on the anatomy of the Tyroglyphid mites in vol. xcii. of the *Sitzungsberichte* of the Vienna Academy.

TUNICATA.—M. Giard notes the finding of the Synascidians *Distaplia rosea* Della Valle and *Diazona hebridica* Forbes and Goodsir on the French seaboard.

FISHES.—M. A. Smith-Woodward has investigated the anatomy and scientific position of the Liassic Selachian, *Squaloraja polyspondyla*. Certain individuals, presumably females, are without the cephalic spine. He proposes a new family, to be placed between Pristiophoridæ and Rhinobatidæ.

Dr. Ramsey describes the common Jew-fish of Port Jackson as new, under the name of *Sciæna neglecta*, and points out the differences between it and *S. antarctica* Castlenau and *S. aquila* Lacépède, the species to which it has previously been referred. Evidence is also given that *Callionymus reevesii* is not the female of *C. curvicornis*.

Mr. Ogilby, of Sydney, describes *Pimelopterus meridionalis*.

REPTILES AND BATRACHIA.—Mr. G. A. Boulenger describes as new three South African tortoises, *T. trimeni*, *T. smithii*, and *T. fiski*, all allied to *T. geometrica*.

The taxidermist of the Victoria Museum at Jaffna, Ceylon, who died from the bite of a cobra which he presumed to be harmless, since its poison-bag was extracted, was for a while resuscitated by artificial respiration, and stated that while paralyzed by the poison he could see, hear, and feel everything, though utterly incapable of motion. Inflammation of the lungs caused his relapse and death.

Mr. G. A. Boulenger has discriminated two forms of Bombinator in Central Europe.

AVES.—Mr. Seebohm inclines to the assumption that the reason that the eggs of birds breeding in holes are white is that nature spares useless color, and he points out that there are traces of spots on the eggs of petrels and puffins, which breed in holes, a fact which tends to prove that it is only recently that they discontinued breeding in open places, like their relatives, the auks and gulls, which lay highly-colored eggs. He also points out that the females of pheasants and humming-birds, which breed in the open, are soberly colored, while the female kingfisher, who incubates concealed, is as gay as her mate.

MAMMALIA.—M. A. T. de Rochebrune has shown that the Colobi are platyrhinous, like the apes of the New World.

C. W. de Vis has described as a probably new species of tree-kangaroo a specimen obtained in the Danitree River District. It is named *Dendrolagus bennettianus*, and is stated to be more nearly allied to *D. dorianus* than to *D. lumholtzi*.

EMBRYOLOGY.[1]

The Development of the Carnivora.[2]—A. Fleischmann has lately carried out some interesting new investigations upon the development of the Carnivora, under the direction of Professor E. Selenka, in the Zoological Institute at Erlangen, on which he reports as follows:

Material was hard to obtain, in spite of the fact that cats and dogs are to be found as pets in every family. From one hundred to one hundred and fifty cats were examined weekly during the rutting periods in February and June. Later it was found possible to obtain materials from animals kept in confinement. Besides this, useful material was obtained through sportsmen from foxes and wild-cats.

A series of stages of the domestic cat was obtained by the successive extirpation of the horns of the uterus. The preservative fluid was picro-sulphuric acid, to which one-tenth per cent. of chromic acid had been added.

[1] Edited by Prof. JOHN A. RYDER, Biological Department, University of Pennsylvania, Philadelphia.

[2] Zur Entwickelungsgeschichte der Raubthiere, Biolog. Centralbl., vii., 1887, No. 1, pp. 9–12.

Fleischmann has not yet been able, in spite of great care and patience, to find the ova of the cat and dog in process of segmentation in the oviducts. The youngest ovum which he found was a somewhat oval blastosphere, upon which the germinal area was already very distinct. This was invested by a very distinct Rauber's layer of cells.

The youngest blastosphere of the cat was nearly spherical, and twelve days after the first copulation still presents the form of an oblong sphere. Through rapid growth at the poles it soon, however, becomes citron-shaped; the germinal area then forms a convex elevation on the middle third of the blastosphere.

While the blastosphere of the dog retains the two-pointed, citron-shaped form, that of the cat retains that form for only a very short time, and gradually becomes barrel-shaped, in that the points of the blastosphere are pressed inward by mutual pressure in the successive sections of the uterine cornua, so that the ends of the growing blastospheres are only feebly conical. The flattened extremities of the blastosphere are not undergrown by mesoderm, and therefore no vessels are developed in that portion of them. At the outer margins of the flattened ends of the barrel-shaped ovum there is a delicate reticulum formed of elevations of the ectoderm, which has apparently arisen by pressure of the ends of the hollow ovum upon the folds of the uterine mucous membrane.

Around the entire germinal area and at the opposite side of the blastosphere, on the twelfth day, there are already formed small projections and elevations of the ectoderm, which serve to attach the ovum to its nidus. Before the allantois has reached any considerable dimensions the subzonal membrane has thrust out villi in all directions, and into these grows the connective tissue supporting the outer vascular layer of the allantoic sac.

The primitive groove is formed in the germinal area at right angles to the long axis of the blastosphere; the same direction is assumed by the medullary groove. At about the sixteenth day the entire germinal area changes the direction of its axis to one parallel with that of the axis of the ovum, a condition which the embryo maintains until birth.

In the primitive streak the mesoderm is formed exclusively from the outer walls of the primitive groove; in many sections one sees the mesoderm proliferating outward from the sides of the primitive streak between the two primary embryonic layers, and numerous cleavage figures indicate rapid growth in this region. The entoderm is always distinctly marked off from the mesoderm, and the author could not obtain clear proof of the entoblastic origin of the mesoderm. Even at the anterior end of the medullary groove the mesoderm is always sharply marked off from the other layers; a heaping up of the mesoderm on the entoderm as described by E. van Beneden is not apparent.

The mesoderm is characterized in well-preserved germinal areas, from eleven to thirteen days old, as a solid mass of cells, which is composed of several layers of cells under the germinal area, but consisting, outside of the latter, of but a single layer of cells.

The cœlom first appears as clefts in the mesoblast outside of the germinal area, and is pushed in under the latter at a later period.

A chordal canal is always developed, and opens at a number of points into the cavity of the umbilical vesicle or yelk-sac; and opening of this canal into the anterior end of the primitive streak was not discovered. Only in an advanced embryo, with ten somites, could a slight ectodermal depression be discovered at the anterior end of the primitive streak, but this was closed below by a mass of cells.

In front of the medullary groove lies a completely closed mass of mesoblast; the interamniotic pore, described by E. van Beneden and Julin, was not observed in young germinal areas.

The anterior amniotic fold in the cat, dog, fox, and mole is not covered by mesoderm, but consists wholly of ectoderm and entoderm. It follows from this that there is found a proamnion not only in Rodents, Bats, and Marsupials, but also in Carnivora and Insectivora, from which it may be concluded that it is a structure common to the Mammalia. The significance attached to it by Van Beneden the author cannot share.

The Wolffian duct does not arise as a solid cord of cells, but, as the author observed in the Duck, as a diverticulum of the cœlom; that the ectoderm takes part in the formation of the Wolffian duct was not established.

As respects the formation of the maternal placenta, the author fully confirms the statements of Bischoff, that the villi of the chorion grow into the uterine glands, destroying the latter.

PHYSIOLOGY.

Experiments with Pig Feeding.—In this Bulletin only a small part of the details of the experiment are given. A full account will appear in the Annual Report for 1886.

The experiments were undertaken—

1st. To produce flesh at least expense;

2d. To produce flesh most rapidly, expense not being considered;

3d. To produce most edible meat, time and expense not to be considered.

Early in March eight sow pigs were selected and put in pens as follows: Pen 1, two Berkshires and one Poland China; Pen 2, two Poland Chinas and one Berkshire; Pen 3, two Berkshires. They were not doing well when put up, and were fed until April 27 before the experiment was begun. The food from this time

consisted of the following: Pen 1 (cheap food), corn meal cooked with twice its weight of skimmed milk, giving a nutritive ratio of 1 : 5; Pen 2 (rapid fattening), pea meal cooked with twice its weight of skimmed milk, giving a nutritive ratio of 1 : 2.6; Pen 3 (for lean meat), equal parts corn meal and pea meal cooked with an equal weight of whole milk, giving a nutritive ratio of 1 : 3.6.

The nutritive ratio of the rations given the second lot is very narrow, and that of the third, also quite narrow.

On several occasions lack of food compelled the substitution of raw whole corn for meal and corn meal for pea meal; but the time was so short and consequently the amount of food not properly in the ration thus consumed was so small that it could not materially affect the results.

The experiment extended through ninety-two days. The weight of the pigs and the gain in weight for each interval between weighings are shown in the following table:

		April 27, at Beginning.	June 8, 42 Days.	June 16, 8 Days.	June 23, 7 Days.	June 30, 7 Days.	July 8, 8 Days.	July 15, 7 Days.	July 22, 7 Days.	July 28, 6 Days.	Total Increase in Weight.	Average Gain per Pig per Day.
		Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Pen 1...	Weight.....	212	450	504	532	560	600	638	642	655		
	Increase.....		238	54	28	28	40	38	4	13¾	443¾	1.61
Pen 2...	Weight.....	194	434	476	520	540	600	600	606	629½		
	Increase.....		240	42	44	20	60	0	6	23½	435½	1.59
Pen 3...	Weight.....	192	366	400	432	438	462	474	500	496½		
	Increase.....		174	34	32	6	24	12	26	−3½	304½	1.66

Those fed upon corn meal and skimmed milk gained in flesh the most steadily. During the hot weather in July they all had variable appetites and gained little in flesh; those in Pen 3 lost three and one-half pounds during the last six days.

By dividing the experiment into two sections of forty-two days each (for convenience in calculation, leaving out the eight days from June 8 to 16, in the middle), it will be seen that much the larger part of flesh was laid on during the first half of the trial:

	Pen 1.		Pen 2.		Pen 3.	
	First 42 Days.	Last 42 Days.	First 42 Days.	Last 42 Days.	First 42 Days.	Last 42 Days.
Gain in flesh—Pounds.....	238	151¾	240	153½	174	96½

The cost of the food eaten by the pigs in Pen 1 and in Pen 2 was greater during the last than during the first forty-two days,—*i.e.*,

more food was consumed to produce the smaller weight of flesh. The third lot ate more food during the first forty-two days, but gained nearly twice as much flesh as during the last forty-two days. The following table exhibits the cost of the food consumed during these two periods and the cost of the food required to produce one pound of flesh:

	Pen 1.		Pen 2.		Pen 3.	
	First 42 Days.	Last 42 Days.	First 42 Days.	Last 42 Days.	First 42 Days.	Last 42 Days.
Cost of food eaten ..	$7.96	$9.99	$13.56	$14.05	$17.18	$14.15
Cost of food to produce 1 lb. of flesh..	0.0293	0.0645	0.0565	0.0918	0.0987	0.1505

At the average price per pound paid for swine for slaughtering, it is seen that during the early part of the trial, and with the first ration only, was the feeding profitable.

The second ration produced flesh but little more rapidly, and, taking the whole trial, produced less than did the first ration, although the former was designed for that purpose. Whether the object sought by the third ration was accomplished could not be told without slaughtering the animals. For this purpose the pigs were all slaughtered at the close of the experiment and the parts weighed separately, and, with the carcass of one pig from each pen, the lean meat and fat were separated to determine the per cent. of each.

In the following table are shown the weights of the different parts of the carcass and the per cent. of lean meat in ham, shoulder, and side:

One Pig from	Weight of								Per cent. of Lean Meat in			
	Whole Carcass.		Hams.		Shoulders.		Sides.		Hams.	Shoulders.	Sides.	The 3 Parts.
	Lbs.	oz.	Lbs.	oz.	Lbs.	oz.	Lbs.	oz.				
Pen 1 ...	215	8	41	8	44		82	0	63.9	67.4	34.1	55.13
Pen 2 ...	193	0	42	8	42	0	71	8	61.8	61.9	29.0	50.90
Pen 3 ...	200	4	38	2	49	12	71	8	56.1	50.5	25.9	44.17

The corn meal and skimmed milk was found more valuable for the production of lean meat than the ration selected especially for this purpose. Not only did it cost less to produce it, but a larger quantity was produced in a given time.

In this experiment the corn meal and skimmed milk proved the best ration for all the purposes for which the experiment was undertaken.—*Report of Ohio Agricultural Experiment Station, December*, 1886.

PSYCHOLOGY.

Sex in Government.—The task which those persons have undertaken who desire to change the present relations of women to government in this country is a formidable one. We refer to the woman-suffrage movement. This journal does not enter the domain of politics; but the relations of the sexes have a history far older and deeper than human government, and, as a phenomenon of Nature, they fall within our scope.

To those who have studied the sex problem from the scientific stand-point, the doctrine that the sexes are thoroughly distinct mentally as well as physically goes without saying. That the different functions imposed on each by Nature for countless ages should produce characteristic mental peculiarities follows from all laws of mental evolution. And those of each sex who have had opportunities of studying the other probably agree that such is the fact. A different opinion could only be entertained by persons whose opportunities have been small, or by persons who are themselves not normal types. The plain facts are these: The function of child-bearing has long since incapacitated the female sex for a longer or shorter part of her life from taking any considerable share in the labor necessary for support and defence. Her maternal instinct, apart from child-bearing, is still further destructive of success in these directions. Hence these labors have been undertaken by the male, who is not only free from these disabilities, but has additional adaptations for such work. The result of this division of labor has been to develop the distinctive qualities, and the latter have caused in turn still further divergence of function. It is demonstrated that the sexes of civilized man are more diverse than those of savage and primitive man, both physically and mentally.

The practical question is, Do the peculiarities of women incapacitate them from taking part in government? To answer this question we must examine the nature of the social—and in so far political—contract under which the sexes co-operate. We begin at the beginning. Woman is physically necessary to man. Man is necessary to woman for support and defence. On this basis the superstructures of civilization rest. Exceptions to this law are relatively few and of but temporary duration. Primitively, then, woman was more or less of a slave to man, much as weaker men were to stronger men. The evolution of the moral qualities has of course ameliorated the condition of the weak, and especially that of woman. The present advanced position of woman rests entirely on a foundation composed of the moral qualities of the man. Should these qualities fail her, her position reverts to its primitive stage. Under our present system, should she be treated barbarously by one man, she can call in the aid of other men for her protection. And this she

is very sure of getting if her cause is good, for the administration of justice is one function of government.

Let us suppose that woman should share equally with man the administration of justice. Could she execute her decisions in case of the opposition of men? Not if that opposition should be sufficiently strong. But supposing that a majority of men were on her side, would women stand as good a chance of justice from their own sex as from men? Knowledge of women answers in the negative. We think women generally would prefer to trust men for justice in preference to women. It is evident, then, that in those departments of government which most concern women, their aid is unnecessary. We do not touch on the many questions of government "support and protection," into which women generally do not care to enter.

The primitive reason why men protect and support women remains in as full force to-day as it ever did, and through it the latter get more than justice. And if the diversity of sex characters continues to increase as it has been doing, these reasons will grow stronger instead of weaker. We see no evil in such a prospect. The passion, emotion, or sentiment of love is a great civilizer. Like the lower creation, man puts on his best dress under its influence. No greater evil can befall society than the undervaluation of this sentiment. The slurs upon it, which are so common in society and in the press, come from persons who either do not understand the order of nature, or who are forbidden by some sinister destiny from conforming to it.—*C.*

Immortality of the Personal Consciousness.—A symposium on this subject was recently published in the Easter number of the *Christian Register* (Unitarian) periodical of Boston. Eighteen scientists, all American excepting one (Dr. A. R. Wallace, now in this country), sent short articles expressing their views on the following three questions, propounded by the editor of the *Register:* "1. Are there any facts in the possession of modern science which make it difficult to believe in the immortality of the personal consciousness? 2. Is there anything in the discoveries of science which would support or strengthen the belief in immortality? 3. Do you consider the question beyond the pale of science altogether?"

The replies are various, and may be classified as follows:

1. The evidence from science is opposed to a belief in immortality (4).

A. No affirmative evidence mentioned. Leidy, Ward, Newcomb.

B. Immortality a gift of God. T. S. Hunt.

2. Agnostic (1).

E. S. Morse.

3. Science not unfavorable (8).

A. No affirmative evidence mentioned. Gray, Lesley, Dana, Gould.

B. Evidence derived from revelation. Young, Cook, Hill, Barnard.

4. Evidence from science affirmative (5).

A. No evidence cited. A. Hall.

B. Evidence psychophysical. Pierce, Cope.

C. Evidence spiritualistic. Wallace, Coues.

MICROSCOPY.[1]

EYES OF MOLLUSCS AND ARTHROPODS.[2]

Preparation of Young Pectens from 1–3 mm. long. I. MOLLUSCS.—1. Specimens are placed in a mixture of equal parts of sublimate and picro-sulphuric acid. After ten or fifteen minutes they are washed in thirty-five per cent. and seventy per cent. of alcohol.

2. The shells are then opened and the mantle dissected out with needles. Thus treated, the shape of the mantle is well preserved, whereas if removed before hardening it becomes much coiled and twisted.

3. Each mantle edge may be cut, according to its size and curvature, into three or four pieces, and these will then lie sufficiently straight for convenient sectioning.

It is necessary to use a different reagent for nearly every part of the eye.

The Rods.—Chromic acid gives the most varied results according to the strength, time of action, and temperature of the solution, or by various combinations of these three. For instance, one-twentieth to one-fifth per cent. for thirty to forty hours failed to give any conception of the structure of the rods, while other parts of the retina, and of the eye itself, were well preserved; but when allowed to act for half an hour at a temperature of from 50° to 55° C., perfectly preserved rods with their nervous net-works are obtained, while, on the other hand, the remaining tissues become so granular and homogeneous as to be unfit for study. This treatment allows the rods to be removed in flakes and their ends examined without the aid of sections. *It is only in this way that the axial nerve-loops can be observed.*

The Lens.—The lens is best prepared for sections by either sulphuric or picro-sulphuric acid; by the first reagent its shape is best retained, and the lens itself is less liable to be drawn away from the surrounding tissue; the latter reagent, however, brings out more sharply the configuration of the cells and allows a better stain of the nuclei to take place.

The Retinophoræ.—The retinophoræ are well preserved by nearly all the reagents; but in sublimate, in picric acid, or in

[1] Edited by C. O. WHITMAN, Ph.D., Milwaukee, Wisconsin.

[2] Dr. Wm. Patten, Mitth. a. d. Zoöl. Station z. Neapel, vi. p. 733, 1886.

their combinations, they become slightly granular, and remain so closely packed that it is difficult to distinguish the cell boundaries. Chromic acid, one-fifth per cent. for three or four days, contracts the cells and gives preparations in which the boundaries and general arrangement of the retinophoræ are easily studied.

Sections of the Eye.—In order to obtain the best sections of the adult eye with *all* the parts in the most natural position, it is necessary to treat them first with one-tenth per cent. of chromic acid for half an hour, then in one-twentieth per cent. for twenty-four hours; one-tenth per cent. for twenty-four hours, and finally one-fifth per cent. for forty-eight hours or more. Next to this method, it appears that solutions of sulphuric acid (twenty drops to fifty grammes of water) give the best preparations (for sectioning), of everything except the rods.

The double layer of the sclerotica and the fibres penetrating it can be seen in sections of eyes treated twenty-four hours in one-fifth per cent. chromic acid.

Maceration and Dissection.—The *pigmented epithelial cells* of Pectens' eyes and the cells of the *cornea* are easily isolated by treatment with Müller's fluid or bichromate of potash one-half per cent. for two or three days. For the maceration of all other elements weak chromic or sulphuric acid is used. For the outer ganglionic cells, which are very difficult to isolate, maceration in one-fiftieth per cent. chromic acid gives excellent results, after previously fixing the tissue in one-fifth per cent. for a few minutes.

For the *retinophoræ*, one-twentieth per cent. for four or five days proves very useful.

Sulphuric acid, five drops to thirty grammes of sea-water, gives the best results for the nerve-endings in the retinophoræ (not in the rods) and for the nervous inner prolongation of the outer ganglionic cells.

In order to isolate pieces of the cornea with the subjacent *pseudo-cornea* and the circular fibres on the outer surface of the lens, it is better to macerate the eyes in sulphuric acid as given above. The same treatment retains to perfection the natural shape of the lens, which may then be isolated and its surface studied to advantage.

It is necessary for the study of the *circular retinal membrane*, the *septum*, and the *retina* itself, to isolate the latter intact. Maceration in chromic acid either makes the retina too brittle or too soft, while the axial nerve-fibres remain so firmly attached to the retina that it is difficult to isolate it without injury. But this may be easily and successfully done by maceration for one or two days in the sulphuric acid solution. By this treatment the *retina*, together with the *septum* and *circular retinal membrane*, may be detached entire.

Surface views of the retina show the peripheral outer gangli-

onic cells. The *argentea* may be very easily separated in large sheets by macerating for four or five days in bichromate of potash of one per cent.

Sulphuric acid is a most valuable macerating as well as *preservative reagent.* In weak solutions (forty drops to fifty grammes) entire molluscs, without the shell, have been kept in a perfect state of preservation for more than six months. For cilia and nerve-endings it is exceptionally good.

The eyes of Arca and Pectunculus may be macerated either in Müller's fluid or chromic acid. Undiluted Müller's fluid in twenty-four hours gives more satisfactory preparations than a weak solution which is allowed to act for a longer period. Chromic acid, one-fifth per cent. for ten or twelve days, gave most of the preparations from which the drawings of the nerve-endings were made. A few drops of acetic and osmic acid added to distilled water give a very energetic macerating fluid for the epithelium of marine molluscs. Such preparations led to the discovery of the very delicate outward continuations of the pigmented cover-cells in the compound eyes of Arca.

II. ARTHROPODS.—In order to demonstrate the presence of the *corneal hypodermis* in the faceted Arthropod eye, and the connection of the so-called "rhabdom" with the crystalline cone cells, it is necessary to resort to maceration. In most cases it is hardly possible to determine these important points by means of sections alone.

The ommateum of fresh eyes, treated for twenty-four hours or more with weak sulphuric or chromic acid, or in Müller's fluid, may be easily removed, leaving the corneal facets with the underlying hypodermis uninjured. Surface views of the cornea prepared in this way show the number and arrangement of the corneal cells on each facet. In macerating the cells of the ommateum it is not possible to give any definite directions, for the results vary greatly with different eyes, and it is also necessary to modify the treatment according to the special point to be determined. It is as essential to isolate the individual cells as it is to study cross and longitudinal sections of the pigmented eyes. In determining the number and arrangement of the cells and the distribution of the pigment the latter method is indispensable; it should not be replaced by the study of depigmented sections, which should be resorted to in special cases only.

In *fixing* the tissues of the eye, it is not sufficient to place the detached head in the hardening fluid; the antennæ and mouth parts should be cut off as close to the eye as possible in order to allow free and *immediate* access of the fluids to the eye. When it is possible to do so with safety, the head should be cut open and all unnecessary tissue and hard parts removed. With abundant material, one often finds individuals in which it is possible to separate, uninjured, the *hardened* tissues of the eye

from the cuticula. This is of course a great advantage in cutting sections. The presence of a hard cuticula is often a serious difficulty in sectioning the eyes of Arthropods. This difficulty can be diminished somewhat by the use of the hardest paraffine, and by placing the broad surface of the cuticula at right angles to the edge of the knife when sectioning. Ribbon sections cannot be made with very hard paraffine, but it is often necessary to sacrifice this advantage in order to obtain very good sections.

SCIENTIFIC NEWS.

—Over a year ago the announcement was made that a human skull was found near Worcester, Mass., in such a position with regard to the bones of a mastodon as to indicate that they were contemporaneous. Regarding the authenticity of the mastodon bones there was no doubt, but certain facts seemed to indicate that the human skull was a "plant," but one which was rather skilfully performed. It is now announced that those in Worcester who have been investigating the affair are convinced that the skull was placed where it was found by some one who had a slight knowledge of archæology. As absolute proof is as yet lacking, no names are mentioned, but circumstances point strongly towards a person who is believed to be capable of such a fraud.

—Prof. Herbert W. Conn, of Wesleyan University, will have charge of the biological instruction at the summer school at Martha's Vineyard during the present season.

—*Random Notes on Natural History*, a small monthly magazine started in 1884 by Southwick & Jencks, of Providence, R. I., has been discontinued. The three volumes published contain many notes on the natural history of Rhode Island.

—The announcement has already been made in these pages that early in the present year Ginn & Co., of Boston, were to start a *Journal of Morphology*, under the editorial charge of Dr. C. O. Whitman. We recur to the subject to say that the first number will be issued some time during the present month, and to call the attention of all persons interested in the anatomy, histology, or development of animals and plants to the claims of this journal. It will be the endeavor to make it the equal and the representative in America of such periodicals in Europe as the *Zeitschrift für wissenschaftliche Zoologie* and the English *Quarterly Journal of Microscopical Science*. The name of the editor is a guarantee that the contents will be of the highest character. The plates will be fully equal to those of the best of the foreign journals. Such a journal has long been a desideratum, and it is the duty of every American student to support it.

The subscription price for the present has been fixed at six dollars per annum.

—Dr. A. T. Bruce, one of the more promising of the younger American zoologists, died at Cairo, Egypt, February 11, 1887. He was a graduate and for a while an assistant at Princeton College, and then pursued post-graduate studies at Johns Hopkins University, where he received the degree of Ph.D. His health had become impaired by overwork, and at the time of his death he was on his way to Japan. He died of local fever, which his constitution was not strong enough to resist. One of his former instructors writes, "It is a great loss to me; he was always a charming fellow." He had published only preliminary results of his studies, which were chiefly in the line of the development of Arthropods,—spiders, Lepidoptera, Orthoptera, and, with Dr. Brooks, Limulus.

—The announcement is made that those desiring aid for scientific research from the Elizabeth Thompson fund should make early application to the secretary of the trustees of the fund, Dr. C. S. Minot, Harvard Medical College, Boston, Mass. All applications should state clearly the amount wanted, the purpose for which wanted, and other details, to aid the committee in making their awards. The awards will probably be made in May.

—S. H. Vines, the eminent English botanist, has been given the degree of D.Sc. by the University of Cambridge, England.

—The Academy of Sciences of Berlin has recently made its awards for the furtherance of science, among which may be noted three hundred and seventy-five dollars to Karl Brandt to continue his studies of the Radiolaria, two hundred and fifty dollars to Dr. Ludwig in furtherance of his Echinoderm investigations, and nine thousand dollars in aid of various scientific publications, most prominent of which are Dohrn's "Zoologisches Jahresbericht" and Dr. Taschenberg's "Bibliothek."

—In a recent number of the *Natural History Transactions* of the Northumberland, Durham, and Newcastle-on-Tyne Societies occur twenty letters from the late Charles Darwin to Albany Hancock relating to the barnacles. They are interesting reading, especially since they display the caution with which Mr. Darwin worked.

—For five years the Women's Education Society of Boston has supported the Marine Laboratory at Annisquam, of which frequent mention has been made in these pages. Recently a meeting was held in Boston, at which the further continuance of the laboratory was discussed. Remarks were made by and letters read from those who were acquainted with the work done, and it was the general sense of the meeting that the laboratory

be placed on a permanent footing, with paid assistants and every facility for elementary instruction, as well as original investigation. A board of directors was elected and various committees appointed to take action as to finances, location, and other matters.

—Dr. J. W. Fewkes has been in California during the present winter, engaged in studying the Medusæ of the Pacific.

—Dr. J. S. Kingsley, of Malden, Mass., will have a small laboratory for original biological research at Salem, Mass., during July and August of the present year.

—The *American Monthly Journal of Microscopy* has greatly changed its typographical appearance with the present volume. Under the editorship of Professor H. L. Osborn it is becoming more scientific and valuable.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

New York Academy of Sciences.—March 14.—Prof. W. P. Trowbridge presented notes upon the "Laws of Fatigue and Rest in Animal Mechanics, as applied to Boat-Racing."

March 28.—The following paper was announced: "The Fauna and Flora of the Trias of New Jersey and the Connecticut Valley" (illustrated with specimens and drawings), by Dr. J. S. Newberry.

Biological Society of Washington.—March 19.—Communications: Mr. L. O. Howard, "A Rock Creek Philanthropist;" Mr. Charles Hallock, "Trans-Continental Thoroughfare of the Moose," with some description of its habits; Dr. Tarleton H. Bean, "American and European Work in Deep-Sea Ichthyology;" Mr. F. A. Lucas, "The Occurrence of Lepidoptera at Sea;" Capt. Joseph W. Collins, "Some Novel Facts in the Natural History of the Codfish;" Dr. C. Hart Merriam, "Contributions to North American Mammalogy—Description of a New Mouse from New Mexico."

April 2.—Communications: Dr. Theobald Smith, "Quantitative Variations in the Germ Life of Potomac Water during the Year 1886;" Dr. Edward Eggleston, "Queries concerning Certain Plants and Animals known to the earliest Colonists of North America;" Prof. Otis T. Mason, "Representations of Animal Forms in Eskimo Art;" Mr. F. W. True, "The Blackfish of our Southern Waters;" Dr. H. G. Beyer, "The Action of Caffeine on the Kidneys."

Boston Society of Natural History.—March 16.—Professor W. M. Davis spoke of the value of classification as a guide in geo-

graphic investigation. Professor F. W. Putnam spoke of perforated stones from Indian graves of California, illustrating his remarks by numerous specimens.

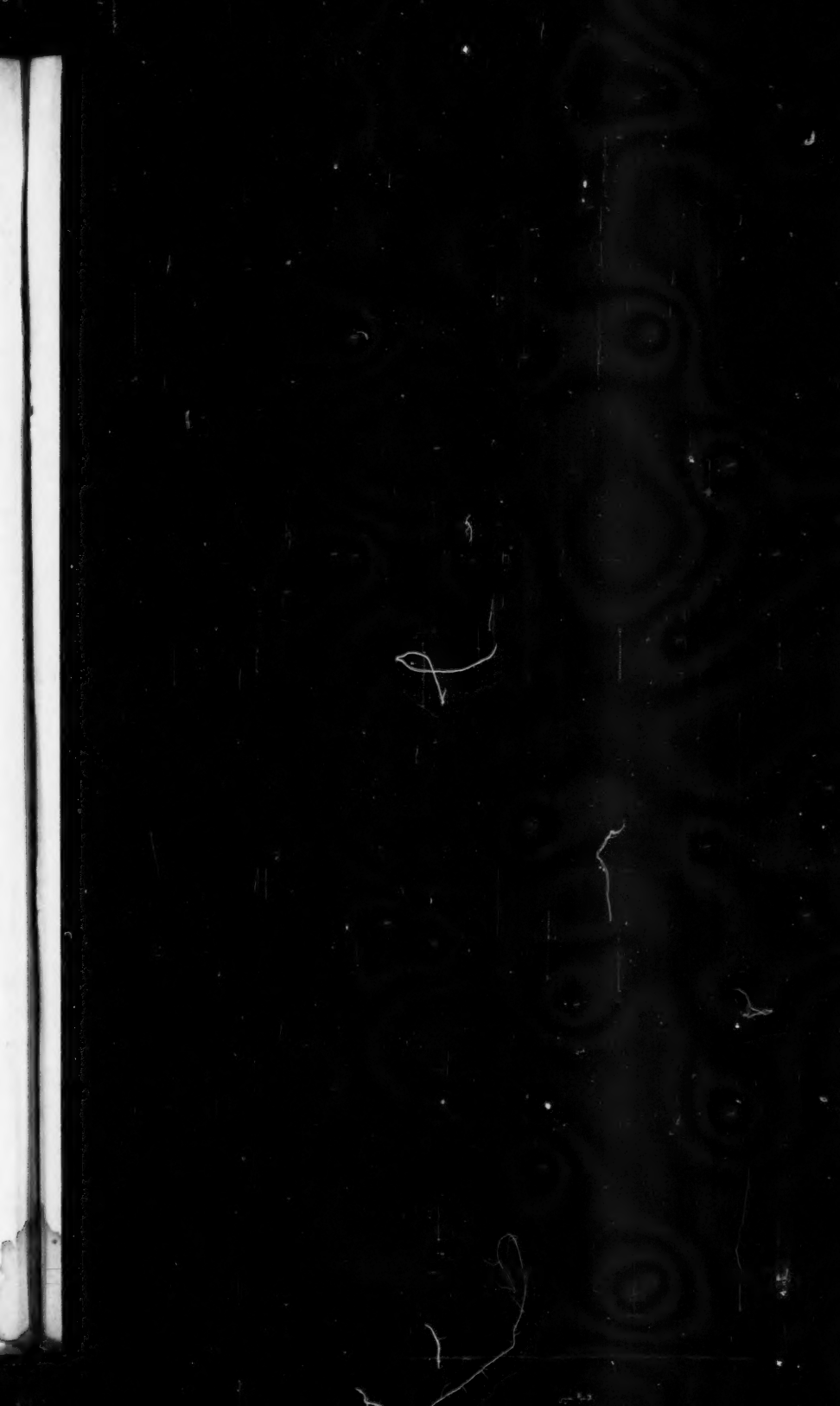
Essex Institute.—February 21.—Professor Frederick W. Putnam gave an account of the explorations of the Peabody Museum of Archæology in the Turner group of mounds in the Little Miami Valley. A partial account of these explorations appeared in the December number of this journal.

March 21.—Mr. W. D. Northend spoke on the settlement of Massachusetts Bay Colony.

American Committee of International Congress of Geologists.—Meeting at Albany, N. Y., April 6. The report of the secretary (Dr. P. Frazer) of the proceedings of the committee at its Philadelphia meeting in December last was read and approved. It was agreed to recommend to American geologists for adoption the general system and scale of colors adopted by the Berlin Congress, with such minor modifications as may be subsequently agreed on, and such additions as American geology renders necessary. The sub-committees on special geology reported as follows: A paper on the Archæan was read by Dr. T. S. Hunt, and verbal discussion by Winchell, Hitchcock, and Frazer. Papers on the Palæozoic were read by Prof. J. J. Stevenson, Prof. H. S. Williams, and N. H. Winchell (Taconic). A paper on the Mesozoic of the interior of the continent was read by E. D. Cope. Papers on the Cænozoic were read from Prof. Eugene Smith for the marine and E. D. Cope for the lacustrine regions. It was agreed to meet at some point accessible to New York a few days before the meeting of the American Association for the Advancement of Science the coming summer, the day to be fixed by the executive committee.

The former plan of preparing reports by sub-committees with separate chairmen was, on motion of Professor Cope, unanimously abandoned, and in its stead reporters were named for the seven subjects into which the geological column was divided. The reporters are charged with the duty of collecting all possible data bearing on their subject, both from within and without the committee, and presenting each what may be considered a *résumé* of the opinions of American geologists on his subject at the next meeting. In some form these reports will then be brought before the Geological Section (E) of the American Association for the Advancement of Science at its session to be held a few days after that of the American Committee, or on August 10 next.

The following are the subjects and reporters: Quaternary, Recent, and Archæology, Major J. W. Powell, Director United States Geological Survey, Washington, D. C.; Cainozoic (Marine), Prof. E. A. Smith, State Geologist, University of Alabama,

Tuscaloosa County, Ala.; Cainozoic (Interior), Prof. E. D. Cope, 2102 Pine Street, Philadelphia; Mesozoic, Prof. George H. Cook, State Geologist, Rutgers College, New Brunswick, N. J.; Upper Palæozoic, Prof. J. J. Stevenson, University of the City of New York, and Prof. H. S. Williams, Cornell University, Ithaca, N. Y.; Lower Palæozoic, Prof. N. H. Winchell, State Geologist, University of Minnesota, Minneapolis; Archæan, Dr. Persifor Frazer, 201 South Fifth Street, Philadelphia.

In order that the geologists of this country should all be properly represented at the next Congress by their national committee, it is necessary that they should assist that committee as much as possible by communicating their views. They are earnestly requested to do so, and in case of their failure they will have themselves to blame if their views are overlooked.